Information Circular 85-3

Tenth Annual Review of Activities

Project Resumés

1985

Edited by

Shasta A. Abbott

Mineral Resources Division
Department of Forests, Mines and Energy
New Brunswick

1985

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SOUTHERN NEW BRUNSWICK

A.A. Ruitenberg, Regional Geologist

The Sussex Regional Office staff consists of A.A. Ruitenberg, Regional Geologist; S.R. McCutcheon, Assistant Regional Geologist (on educational leave); M.R. Mazerolle, Engineering Technician and Mrs. F.H. Kelly, Administrative Services Officer. M.J. McLeod and S.E. Watters are employed on ERDA contracts. P.G. Chiswell was hired for a six month period during the summer field season.

Two projects were initiated under the ERDA agreement with the Government of Canada. These include: a) a detailed geological and geochemical investigation of the tin-tungsten-bearing rocks in the Eastern St. George Batholith and b) a detailed stratigraphic, structural and mineralogical study of the gold-bearing rocks along the Bay of Fundy coast.

Several other projects were continued or started during the season: a) the detailed stratigraphic, petrologic and petrochemical study of the Mount Pleasant Caldera, b) mapping and sampling of tills covering gold-bearing rocks in the Goose Creek area, west of Fundy Park and c) comparative mineral deposit investigations conducted in cooperation with other departmental and company geologists. Figure 1 shows locations of the mapping projects.

Geologists from this office were also involved in the preparation of field guides, conducting field trips and preparing papers for the Geological Association of Canada, Mineralogical Association of Canada, Annual Meeting and the Granite-Related Mineral Deposits Symposium organized by the Canadian Institute of Mining and Metallurgy which were held, respectively, in Fredericton and Halifax.

ST. GEORGE BATHOLITH TIN-TUNGSTEN PROJECT

M.J. McLeod started a geological mapping and geochemical sampling program in the eastern lobe of the St. George Batholith this summer. Most of the work to date has been restricted to the western part of this area where both ample exposures and good access are afforded by new logging roads.

Three phases of biotite granite of probable Carboniferous age have been delineated. The oldest phase comprises several variably textured, coarse-grained rocks. Textural types vary from seriate and hiatal to sub-equigranular with variable proportions of crystals with rapakivi textures. Tin- and tungsten-bearing greisen vein swarms occur locally in this unit.

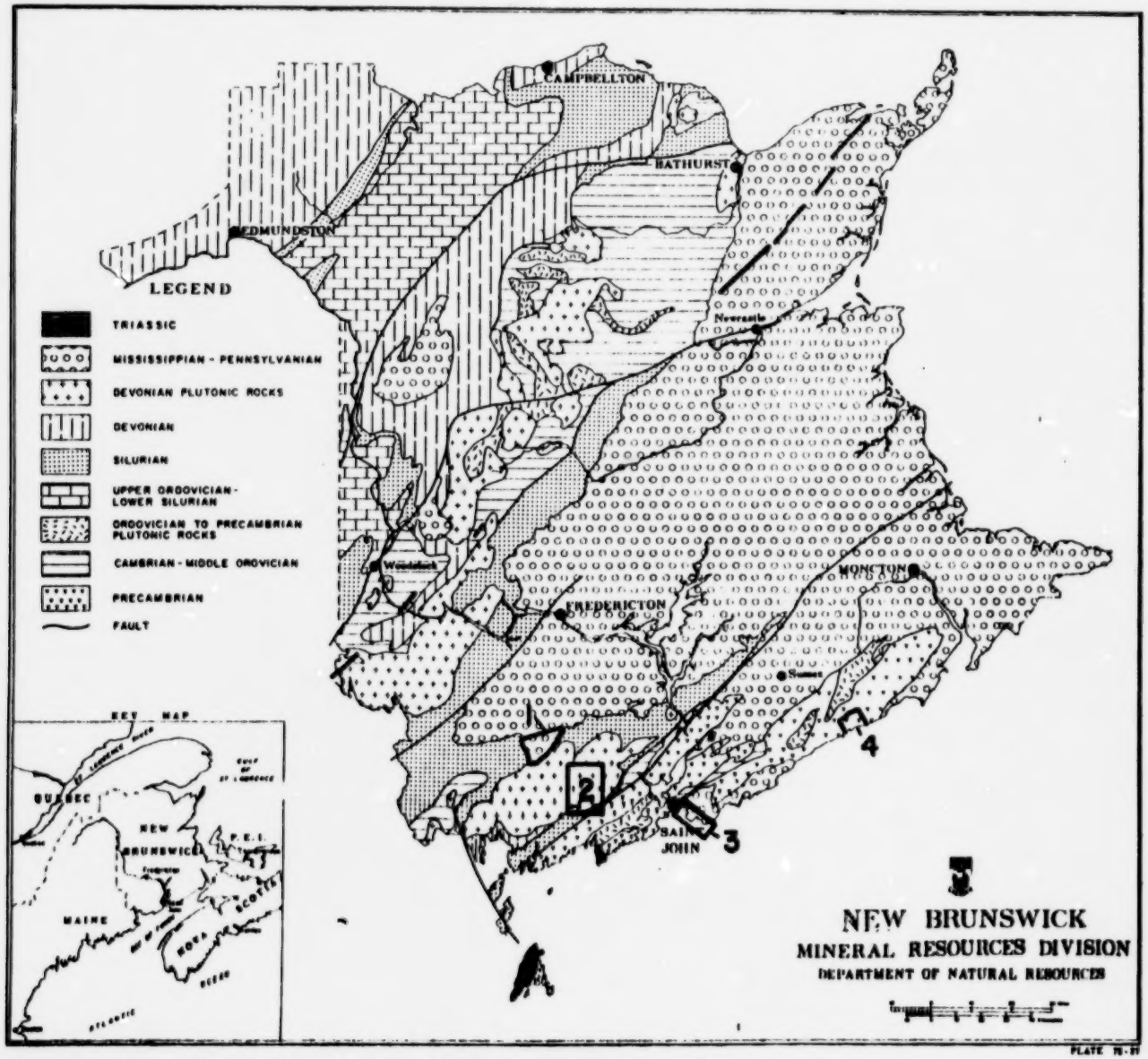

Figure 1. Field Projects, Sussex Regional Office:

1. Mount Pleasant Caldera project;
2. Eastern St. George Batholith tin-tungsten project;
3. Bay of Fundy gold-bearing rocks project;
4. Goose Creek till mapping and sampling project.

The coarse-grained unit is intruded by a medium- to fine-grained equigranular phase and by a granophyric, porphyritic unit with abundant associated aplite and pegmatite. Age relationships between these two phases are still uncertain because contact relationships are commonly difficult to determine.

The equigranular phase is fairly uniform in texture and forms a distinct elongated mappable unit. Economically, the most interesting greisen vein swarms and alteration zones occur within and peripheral to this unit.

The porphyritic unit is widely dispersed throughout the coarse-grained phase and forms both discrete mappable units and isolated small intrusions. Phenocryst content varies considerably in a given exposure and development of rapakivi textures is sporadic. Several small cupolas formed by the porphyritic unit or equivalent aplites intruding the coarse-grained unit are exposed. Greisen vein swarms are commonly associated with the cupolas but also occur erratically throughout the units.

Within this geological framework, the phases have been extensively sampled for detailed petrographic studies, chemical analyses and age dating. The greisen veins and other mineralized zones in and around the study area have also been sampled for further detailed work.

It is anticipated that these studies will lead to a better understanding of the mineralizing systems in the batholith and thus provide a reliable exploration guide.

BAY OF FUNDY GOLD-BEARING ROCKS

S.E. Watters started a detailed stratigraphic, structural and mineralogical investigation of the gold-bearing rocks along the Bay of Fundy coast in July of 1985. The study was concentrated this year mainly along the coastal section between Cape Spencer and Saint John Harbour (Figure 2), where several gold occurrences have been identified. Extensive sampling of various stratigraphic units and alteration zones was carried out for gold analysis, dating and petrographic examination.

The lowermost part of the mapped sequence is well exposed in the coastal section between Cape Spencer and Mispec Branch. The lithologies are mainly Carboniferous or older greyish purple and purple siltstone, and poorly sorted sandstone and polymictic conglomerate. Limestone beds are locally interbedded with the clastic sedimentary rocks. Arkosic conglomerate and sandstone are abundant near the unconformable contact with underlying Late Precambrian or Early Paleozoic granite and granodiorite which is well exposed at the Cape Spencer Lighthouse and southwest of Millican Lake. Northwest of Cape Spencer, the lowermost unit is

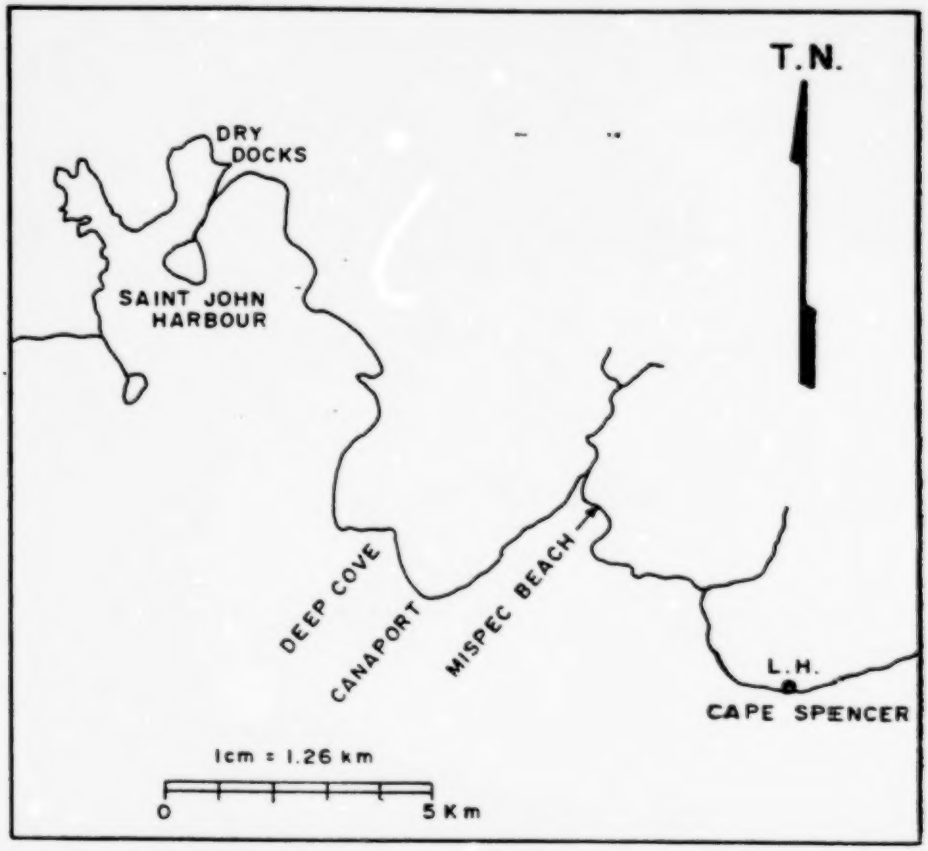

Figure 2. Part of Bay of Fundy coastal area mapped and sampled in detail during 1985 (Also shown on Figure 1 as Field Project 3).

overthrust onto Carboniferous, grey, quartzose, plant-bearing sandstone and quartz-pebble conglomerate. These Carboniferous sediments are intensely folded immediately below the sole of the thrust. Rocks of the lowermost unit are also exposed near Deep Cove, northwest of Cape Spencer, but the contact relationships are uncertain in this area.

The lower part of the section between Mispec Beach and Canaport consists of Carboniferous, purplish red, well-sorted, quartzose sandstone, siltstone, slate and minor quartz-pebble conglomerate. The upper part of this section consists of purplish red, moderately sorted, quartzose sandstone, siltstone and polymictic conglomerate. The contact between this section and the previous one is concealed.

The section between Canaport and Black Point is similar to the Mispec Beach - Canaport section except for the local presence of reddish brown muddy siltstones and conglomerates which possibly represent a braided stream facies.

The coastal section between Black Point and the Saint John Dry Dock is poorly exposed except for the northwestern part where grey and greyish green siltstone, shale, sandstone and conglomerate of the Carboniferous Lancaster Formation outcrop.

The entire mapped sequence is intensely folded but the most intensive deformation occurs in the section between Mispec Beach and Cape Spencer. The folds plunge gently northeast or southwest and they vary in size from a few decimetres to several metres. The rocks are also extensively thrusted, both to the northwest and southeast, and the folds are commonly related to the thrusting. Major thrusts juxtapose sequences of contrasting sedimentary facies, but the distinction between such contrasting facies is partly masked by buff to buff-green alteration effects that occur up to several metres both above and below the thrusts.

Cleavages measured in the rocks include an early penetrative cleavage, which is parallel or at a shallow angle to bedding. A later, generally northwest-dipping, cleavage is axial planar to gently plunging overturned folds that are associated with thrust faults.

Gold mineralization, described previously by A.A. Ruitenberg, occurs in pyrite found mainly along the borders of quartz veins and stockworks. Most mineralized zones have been found in the intensely thrusted section between Cape Spencer and Mispec Beach. The rocks in this section were mapped in detail and sampled for gold analysis and petrographic examination. The mineralized zones occur adjacent to and particularly below major thrusts and in the axial regions of major thrust-related folds. The host rocks of most of the occurrences are the Carboniferous or older sedimentary rocks of the lowermost unit, but one extensively mineralized zone is in Carboniferous plant-bearing sandstone.

MOUNT PLEASANT CALDERA PROJECT

S.R. McCutcheon completed five geological maps at a scale of 1:20,000 covering the Mount Pleasant Caldera, which is the topic of his PhD thesis at Dalhousie University. Some problematic areas in the Caldera were checked during the summer. A suite of samples was collected for oxygen isotope and microprobe studies to resolve some remaining stratigraphic problems. It is planned to have these studies completed next spring, and by late fall a comprehensive report describing the stratigraphy, petrography and chemistry of the rock units will be finalized. It will also include how and where the known mineral occurrences fit in this geologic framework.

GOOSE CREEK PROJECT

P.G. Chiswell and L. Long mapped and sampled the tills covering the gold-bearing rocks in the Goose Creek area, west of Fundy Park. The bedrock geology was mapped earlier by M.J. McLeod.

A grid with a line spacing of 500 m was laid out for the mapping and sampling of the tills. Samples were collected at 200 m intervals along these lines from the humus and B-horizons. A total of 26 pits were dug in order to better determine the till types. Samples were collected from the C-horizon for heavy mineral concentration.

The topography of the Goose Creek area is very rugged and, therefore, the stream valleys are partially filled with colluvium. The remaining area is mostly covered by thick (>1 m) basal till, commonly overlain by a thin veneer of ablation till.

Two main till sheets have been distinguished in the area; one composed mainly of Late Precambrian granite and granodiorite, and one consisting of Late Precambrian mafic volcanic and greyish green clastic sedimentary rocks. In part of the map area, a third sheet mainly composed of purple sandstone and siltstone of possible Cambrian age can be distinguished. Samples collected from the B-horizons were sieved and will be analyzed for copper, lead, zinc, arsenic and gold. The humus samples and heavy mineral concentrates produced from C-horizon concentrates, derived from 10 l samples, will be analyzed only for gold.

MINERAL DEPOSIT INVESTIGATIONS

Field guides on tungsten-molybdenum-tin, gold and potash deposits were prepared by S.R. McCutcheon and A.A. Ruitenberg for the Geological Association of Canada, Mineralogical Association of Canada, Annual Meeting in Fredericton and published by the University of New Brunswick. The guides were prepared on the basis of both published and unpublished geologic data and field examinations.

A paper on the characteristics and tectonic setting of tungsten-molybdenum-tin deposits was prepared by L.R. Pyffe and A.A. Ruitenberg for inclusion in a Granite-Related Mineral Deposits Symposium organized by the geology division of the Canadian Institute of Mining and Metallurgy from September 15-17, 1985. An extended abstract of the paper was published in a special CIM volume edited by R.P. Taylor and D.F. Strong.

A.A. Ruitenberg continued work in the Cape Spencer - Black River area where several new gold discoveries were made as a result of trenching carried out by Mr. Harold McNamara. He also examined mineralized sections north of Cape Spencer together with S.E. Watters.

J.L. Davies and the writer started work on a report comparing gold deposits in New Brunswick. A field trip of gold occurrences in northern New Brunswick, provided by Richard Mann of Noranda Exploration Ltd., was very helpful for the purpose of comparing gold environments in the province.

A field trip was made in the Long Lake and Veneer areas in northern New Brunswick together with H. van Groenewoud, L.R. Fyffe and G. Crouse. The purpose of the trip was to identify till compositions in several well-exposed soil profiles associated with various forest site types. The area will be part of a field excursion organized by the International Union of Forest Research Organization.

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Ruitenberg, A.A. and Davies, J.L. 1985. Gold environments in New Brunswick. Abstract, Geological Association of Canada, Mineralogical Association of Canada, Annual Meeting, Fredericton, p. A53.

NORTHERN NEW BRUNSWICK

J.L. Davies - Regional Geologist

The Bathurst Regional Office has a staff of five persons: J.L. Davies,Regional Geologist; J.A. MacIntosh, Assistant Regional Geologist; Sharon McKinnon, Administrative Officer; André LeBlanc, Technician; and Maurice Belland, Technician. In 1985, Gregory Philpott was contracted for one year under the Canada-New Brunswick Mineral Development Agreement (MDA) to carry out studies on certain gold occurrences (see page 12). The services of D.V. Venugopal are employed from time to time to assist Mr. Philpott. Field assistance in 1985 was rendered by Gregory Keating and Alex Campbell. T.G. Mersereau is assisting in the preparation of the Geocompilation project (see page 10).

The Bathurst Regional Office projects are now funded by Provincial and Federal-Provincial funds.

FEDERAL-PROVINCIAL PROJECTS (MDA FUNDED)

The $23.7 million five year Canada-New Brunswick Mineral Development Agreement entails studies in mineral deposits, geological mapping, stream silt surveys and a compilation of geoscientific data for the Bathurst-Newcastle district. So far, only a small proportion of the funds have been made available for these projects. Budgets for 1985-86 allowed only a modest start in mineral deposit studies and the geocompilation. No funds were available for geological mapping or stream silt surveys in northwestern New Brunswick.

Mineral Deposits

G. Philpott was contracted for a year to compile, map and study the gold deposits in the Nigadoo River-Millstream River area (See page 12).

J.L. Davies compiled available data on a number of other gold occurrences in northern New Brunswick (See Figure 7 and page 19). The Provincially funded work of J.A. MacIntosh (See page 22) augmented this project.

Geoscientific Compilation

This project will initially involve the compilation of all available geoscientific data in northeastern New Brunswick. The area of interest comprises nine 1:50,000 NTS map areas (Figure 3). Funds available in 1984-85, and 1985-86 were only sufficient to produce 1:10,000 topographic base maps (25 per 1:50,000 map sheet) on which the geoscientific information will be plotted.

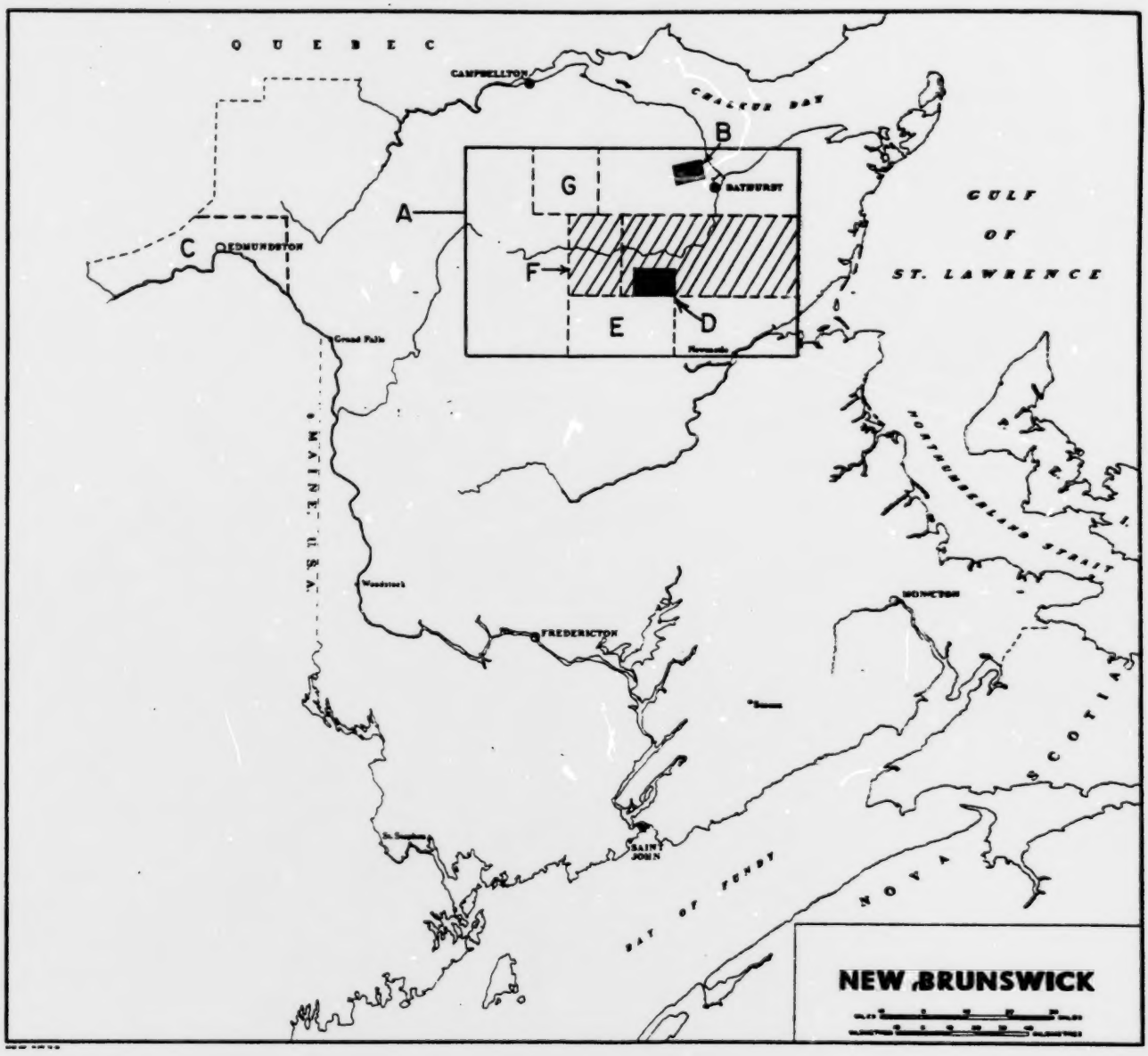

Figure 3. Geoscience projects in northern New Brunswick 1985

A. Geocompilation, shaded areas - 1:10,000 maps in preparation.
B. Gold occurrences - Nigadoo River-Millstream River area
C. Stream silt survey - (in preparation)
D. Geology of 21 O/9 (1/4 mile = 1 inch)
E. Geology of Big Bald Mountain 21 O/1 (1:50,000 in preparation)
F. Stream silt survey 21 O/8 west half, in preparation
G. Reanalysis of stream silt samples for Au, As, Sb and Ba

The base maps (21 O/8 and 21 P/5) are being prepared by Maritime Resource Management Services. It is hoped that money will be available in the fiscal year 1986-87 to allow the Mineral Resources Division to invite consultants to bid on this important undertaking.

PROVINCIAL PROJECTS

Mineral Deposits

J.L. Davies and J.A. MacIntosh have begun a compilation of gold occurrences and a study of gold geochemistry in northern New Brunswick. The resumés follow on pages 19, 22.

R.R. Irrinki has completed a compilation of data on the Cominco-Stratmat and Heath Steele N-5 sulphide deposits. A summary of this project appears on page 23. Work has now commenced on the Key Anacon sulphide deposit.

Stream Silt Surveys

Production of base maps has seriously delayed the publication of the results of silt surveys in northwestern New Brunswick (parts of 21 N/2, N/6, N/7 and N/8) and the California Lake area (21 O/8 west half). It is hoped that this information will be available early in 1986.

Silt samples gathered in the Upsalquitch Forks area (21 O/10) in the early 1980s will be reanalyzed for Au, As, Sb and Ba to help evaluate the gold potential of that area.

Diamond Drill Core

New outdoor racks were constructed at the Madran facility to accommodate part of the large amount of Brunswick No. 6 core received in 1984. Several thousand metres of core from the Canoe Landing Lake sulphide deposit was accepted in 1985.

Other Activities

Several guided tours were conducted in the Bathurst-Newcastle area in 1985. One of these was in connection with the annual meeting of the Geological Association of Canada, Mineralogical Association of Canada, held in Fredericton. A guidebook was prepared for this tour, and it may become the GAC Mineral Deposits Section official guidebook for the district.

The Bathurst Regional Office assisted UNB graduate student Karen Kettles in her study of the Turgeon sulphide deposit, and Jim Alcott in his assessment of the geophysical parameters associated with Heath Steele and Cominco-Stratmat sulphide deposits.

Maurice Belland continued his compilation of assessment work from the Mineral Resources files. His efforts in 1985,were focused on the Rocky Brook-Millstream Fault zone and areas surrounding newly discovered gold showings. Mr. Belland also assists the Regional Geologist in coordinating forestry operations and mineral exploration activities.

André LeBlanc and Sharon McKinnon have been busy keeping up with the widespread staking associated with the gold exploration. Mr. LeBlanc is also assisting in the preparation of the stream silt geochemistry maps of northwestern New Brunswick, as well as drafting the work associated with other programs. He has also acted as claims inspector in disputes involving mineral rights.

J.A. MacIntosh and J.L. Davies are involved in the Petit Rocher Mining Interpretation Centre to be constructed in 1986. In 1985 the planning committee employed a geography student to compile a history of mining and to prepare theme maps for display in the centre. The Regional Geologist expects that the final displays and literature regarding mining and mineral exploration in New Brunswick will require careful editing by the Mineral Resources Division.

The Regional Geologist presented papers at the annual meeting of the Geological Association of Canada and Mineralogical Association of Canada, held in Fredericton, dealing with the geology of the Miramichi Zone and its sulphide deposits, and the geology of the Restigouche and Murray Brook sulphide deposits. He also co-authored (with A.A. Ruitenberg) a paper on gold deposits of New Brunswick.

The Regional Geologist spent a substantial amount of time editing maps and reports in preparation for their publications.

The Regional Geologist is a member of an advisory committee and he also served on a committee to formulate a Professional Development Policy for Department of Natural Resources employees.

GOLD OCCURRENCES OF THE NIGADOO RIVER-MILLSTREAM RIVER AREA (Greg Philpott and J.L. Davies)

Accelerating exploration for gold deposits has emphasized the need for a better understanding of the gold potential of northern New Brunswick. To help fill this gap, a program was initiated in the Nigadoo River-Millstream River area where there is a conspicuous concentration of gold, silver and base metal occurrences. The occurrences are the result of well over 100 years of prospecting and geological mapping; yet only one, the Nigadoo zinc-lead-silver deposit, has been exploited.

The aim of this project is to establish the stratigraphic and structural relationships that control the gold deposits, and perhaps indicate new concepts and areas of interest for gold exploration. The work will comprise a compilation of geoscientific and historical data, detailed geological mapping, sampling and geochemical analysis for a number of elements including gold, silver, arsenic, antimony, copper, lead and zinc.

The project area is underlain by polydeformed turbidites and mafic volcanic rocks of the Ordovician Tetagouche Group, that are in faulted contact with less deformed calcareous siltstone, argillite, greywacke, conglomerate and limestone of the Silurian Chaleurs Group. The supracrustal rocks are intruded by a Devonian granodiorite stock and numerous felsic and mafic dykes and sills. Most of the mineral occurrences occur within or near the edge of the contact metamorphic aureole surrounding the granitic stock.

The structure of the region is dominated by the northeasterly trending Rocky Brook-Millstream Fault system that shows evidence of post-Devonian dextral wrench movement. The subsidiary faults, breccia zones and fractures seem to have provided the hydrothermal plumbing systems associated with Devonian plutonism that have produced several epigenetic mesothermal to epithermal base and precious metal concentrations.

Important base metal and/or gold occurrences are as follows; Nigadoo Zn, Pb, Ag, Au (no. 41, Figure 7); Lavigne Brook Au, As, Ag (no. 90); Stephens Brook As, Ag, Au (no. 121); Rocky Brook Cu, Zn, Ag, Au (nos. 94A and 94B); Bradley Brook (Zarina) Au (no. 105); Bradley Brook Zn, Pb, Ag (no. 104); Nigadoo Au (no. 106); Millstream (West) Pb, Zn, Sb, Ag, Au (no. 91); and Bradley Brook Au (no. 122). All occur in fracture systems within Silurian sedimentary rocks and nearly all are closely associated with the Main Fault of the Rocky Brook-Millstream system.

In 1985, 150 samples were collected and over a hundred of these have been analyzed. Forty-eight thin and polished sections have been prepared so far. These are presently being studied by the writers and D.V. Venugopal. Other field work in 1985 consisted of detailed mapping (still in progress) of two areas (1) the Stephens Brook, Lavigne Brook area, and (2) the Bradley Brook, Millstream River area. Some of the geological relationships are outlined in Figures 5 and 6. (See Figure 4 for index to Figures 5 and 6).

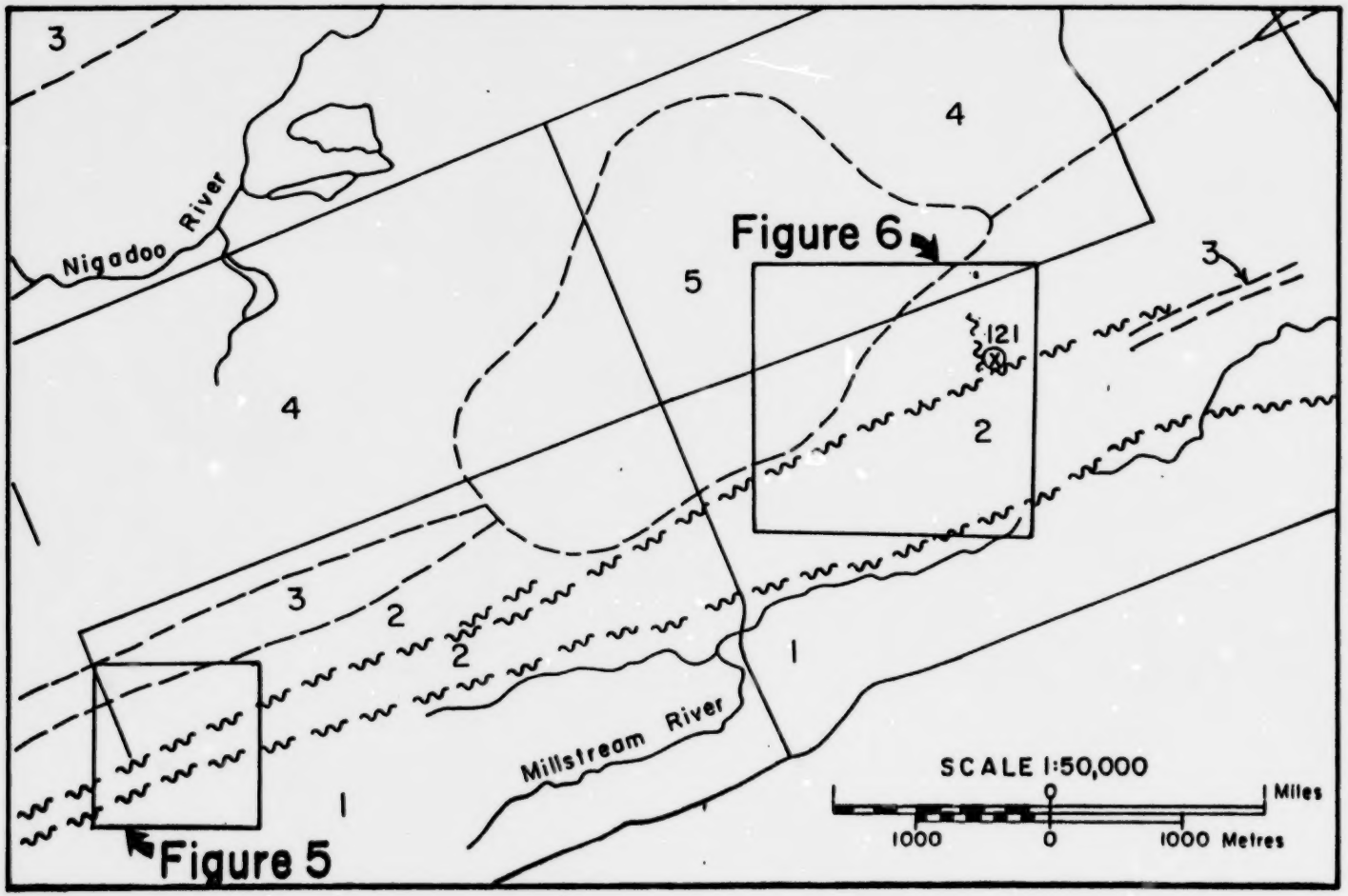

Figure 4. Nigadoo River-Millstream area, Index to Figures 5 and 6
1. Undivided Tetagouche Group
2,3,4. Chaleurs Group
5. Devonian granodiorite

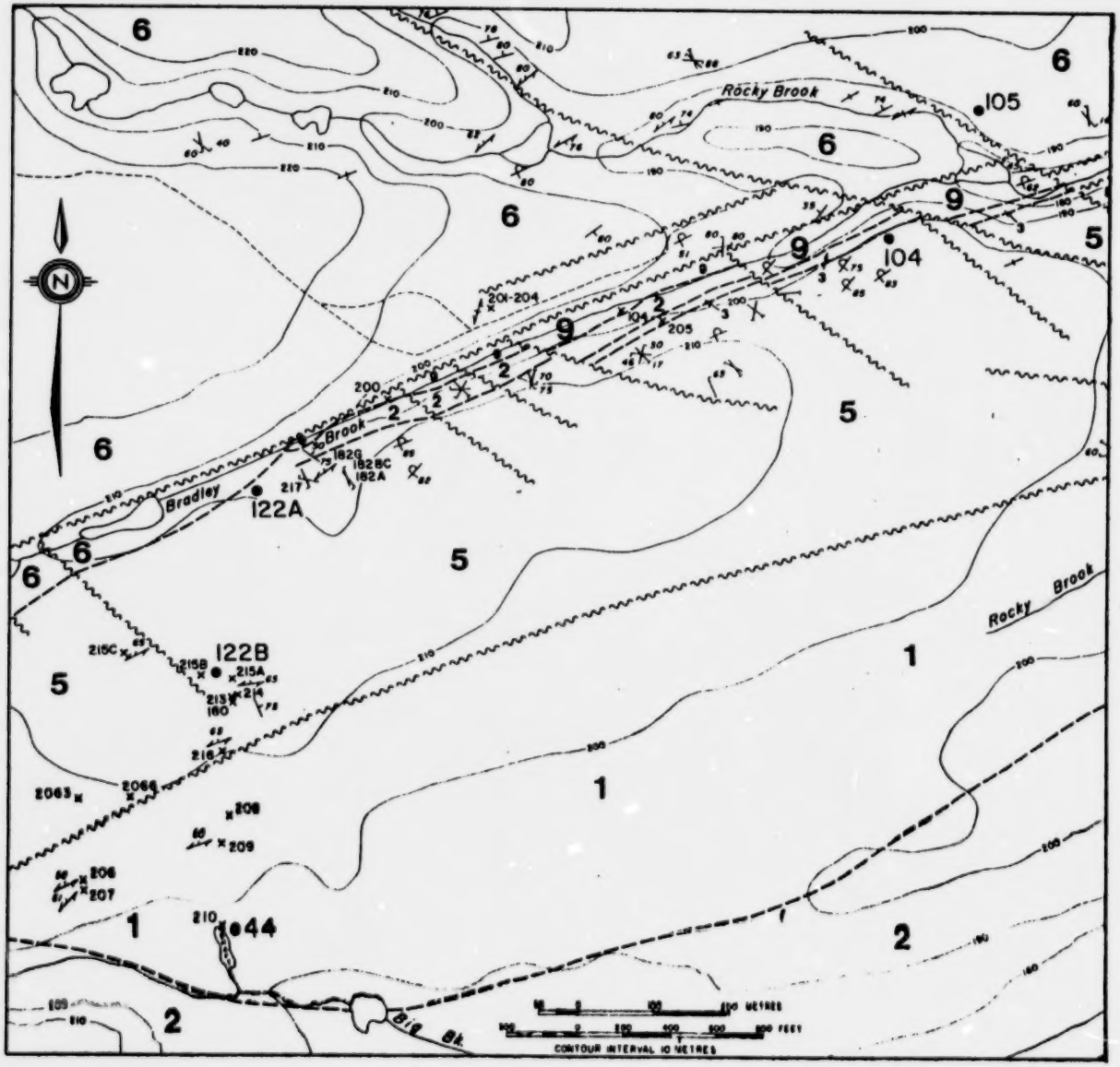

Figure 5. Geology of Bradley Brook, Millstream River area
(Refer to page 17 for Legend and Symbols)

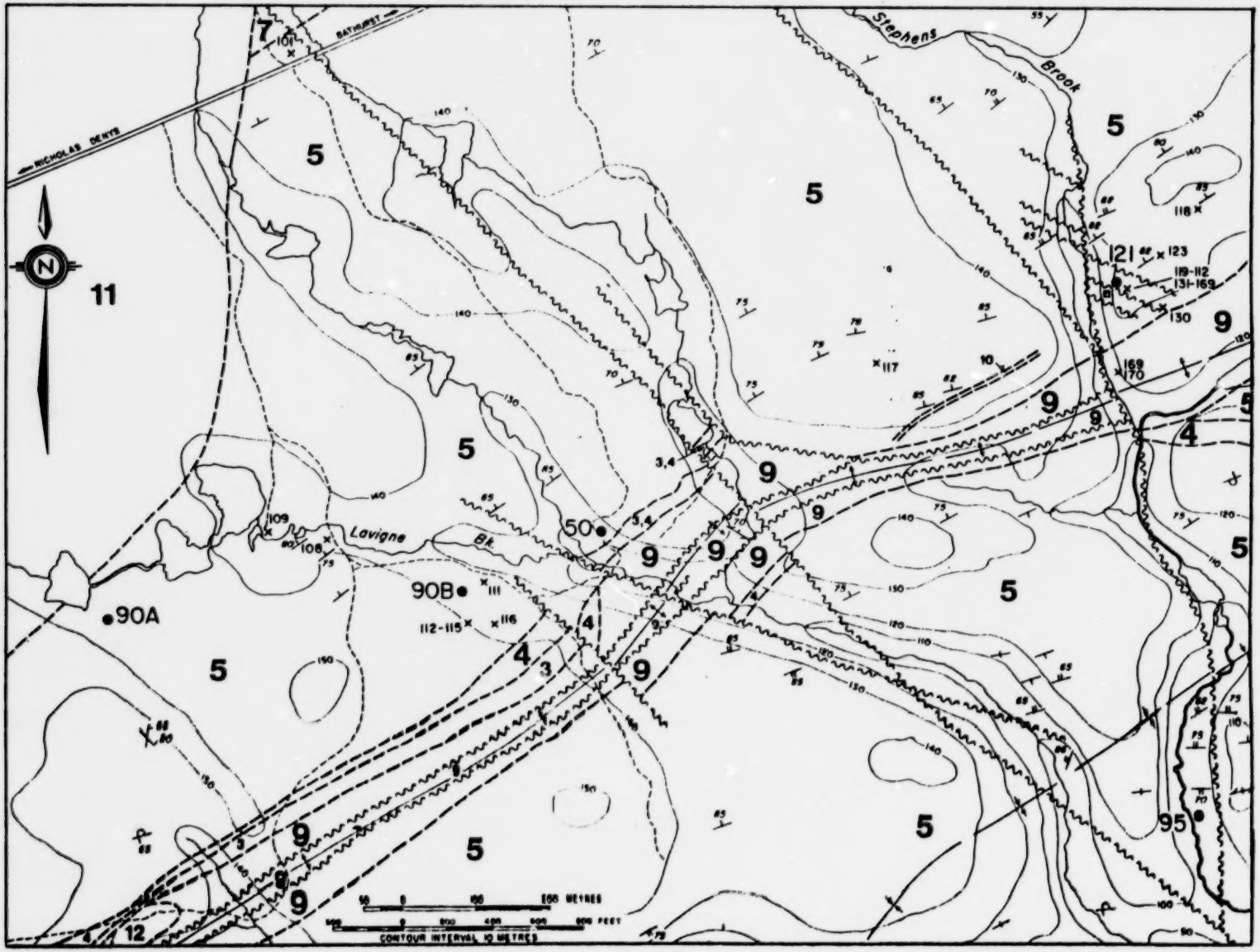

Figure 6. Geology of Stephens Brook, Lavigne Brook area
(Refer to page 17 for Legend and Symbols)

LEGEND AND SYMBOLS FOR FIGURES 5 AND 6

LEGEND

DEVONIAN

12 Aplite, quartz-feldspar porphyry, syenite
11 Quartz monzonite, granodiorite
10 Diabase, diabasic gabbro, gabbro, diorite
9 Serpentinized peridotite; includes serpentine-talc schist, fault gouge and breccia

SILURIAN (Chaleurs Group)

8 Greenish grey slate, phyllite, argillite, sandstone; minor red argillite, phyllite, sandstone and limestone. Hornfels in vicinity of Nicholas Denys granodiorite
7 Conglomerate, grit, greywacke, and argillite, minor slate. Hornfels in vicinity of Nicholas Denys granodiorite
6 Slate, calcareous and ferruginous, with beds of greywacke and quartzite
5 Greywacke, argillite, cherty argillite, slate, minor conglomerate and grit. Hornfels in vicinity of Nicholas Denys granodiorite
4 Limestone, siliceous limestone, derived skarn. Skarn may contain diopside, magnetite, garnet
3 Conglomerate, argillite, greywacke, grit

ORDOVICIAN

2 Diabase, diabasic gabbro, diorite (Tetagouche Group)
1 Dark grey phyllite, graphitic schist and phyllite, argillite, and quartzose subgreywacke; minor siliceous limestone

SYMBOLS

74 / 83 — Bedding, tops known (inclined, vertical, overturned)

65 — Bedding, tops unknown, inclined

35 — Cleavage (inclined, vertical)

65 — Jointing (horizontal, inclined, vertical)

Anticline, syncline

Geological Boundary

Fault

● 44 — Gold Occurrence

× 205 — Sample

Shaft

Highway

Trail

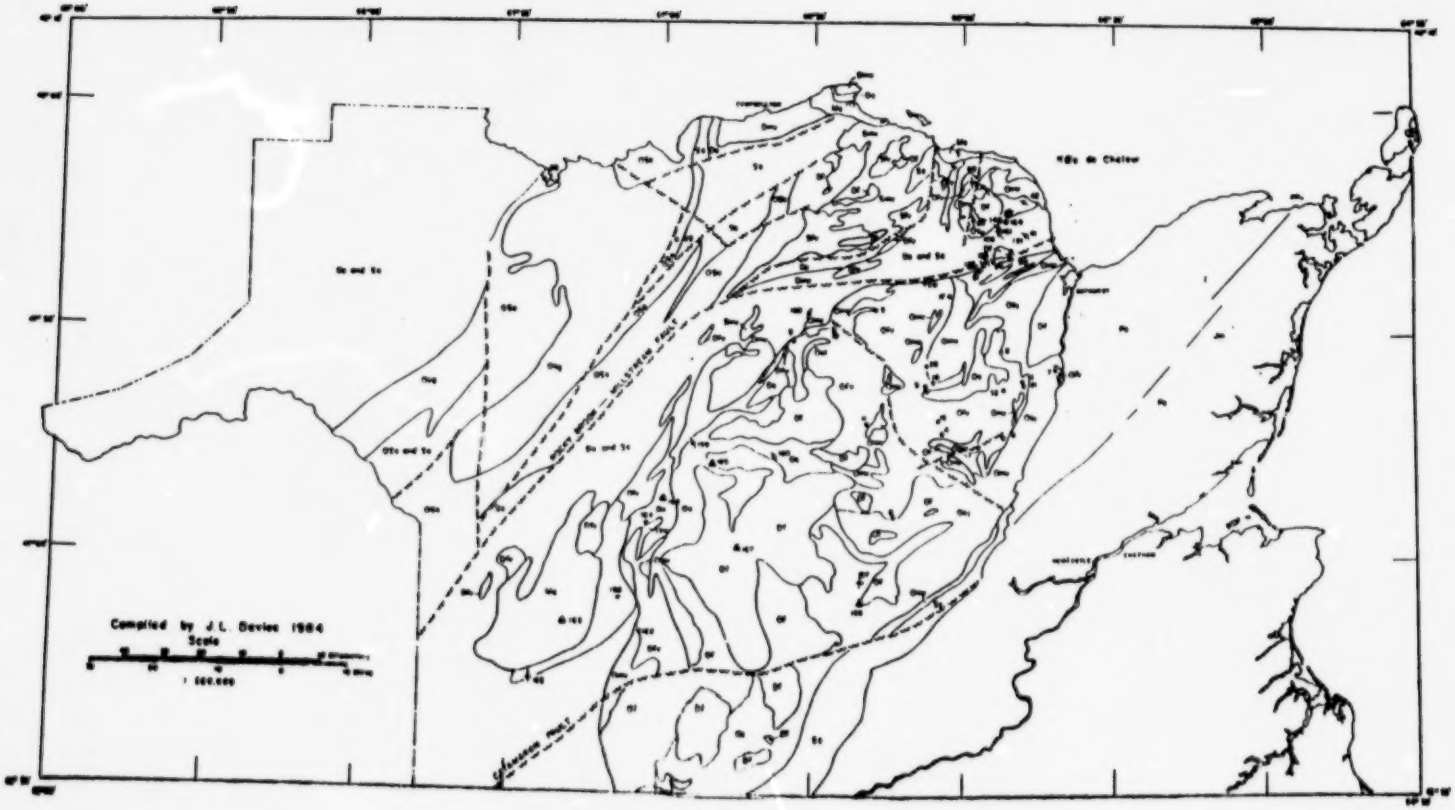

Figure 7. Gold occurrences in northern New Brunswick

MASSIVE SULPHIDE DEPOSITS (LARGEST)

1	Brunswick No.6	Zn, Pb, Ag, Cu, Au
2	Brunswick No.12	Zn, Pb, Ag, Cu, Au
3	Caribou (Anaconda)	Zn, Pb, Ag, Cu, Au
4	Heath Steele	Zn, Pb, Ag, Cu, Au
5	Wedge	Zn, Cu, Pb, Ag, Au
6	Chester	Cu, Zn, Pb, Ag, (Au)
7	Key Anacon	Zn, Pb, Ag, Cu, (Au)
8	Captain	Cu, Zn, Pb, Ag, (Au)
9	Restigouche	Zn, Pb, Ag, (Au)
10	Murray Brook	Zn, Pb, Cu, Ag, Au
11	Halfmile Lake	Zn, Pb, Cu, Ag, Au
15	Stratmat	Zn, Pb, Cu, Ag, Au
16	Canoe Landing Lk.	Zn, Pb, Ag, Cu, Au
17	Armstrong Brook	Zn, Pb, Ag, Cu, Au
20	Orvan Brook	Zn, Pb, Ag, Cu, Au
21	Austin Brook	Zn, Pb, Ag, Cu, Au
22	California Lake	Zn, Pb, Ag, Cu, Au
32	Flat Landing Bk.	Zn, Pb, Ag, Cu, Au

ALLUVIAL (▲)

158	Little S W Miramichi	Au
163	Wapskehegan (Giberson)	Au
165	Serpentine River	Au
166	Campbell River	Au
167	Long Lake	Au

VEINS (✎)

41	Nigadoo Mine	Zn, Pb, Ag, Cu, Au, As
42	Keymet Mine	Zn, Pb, Ag, Cu, Au
53	Mckenzie Gulch (Legacy)	Cu, Ag, Au
55	Patapedia	Cu, Zn, Pb, Ag, Au, As
86	South Antinouri	Cu, Ag, Au, As
89	Mitchell Settlement	Cu, Au
90	Lavigne Brook	Ag, Au, Cu, As
91	Millstream (West)	Pb, Zn, Sb, Ag, Au, As
94	Rocky Brook No.2	Zn, Cu, Ag, Au
105	Bradley Brook (Zarina)	Au, Ag, Pb, Zn, As
106	Nigadoo Au	Au, Pb, Zn, Ag
121	Stephens Brook	Au, Ag, Cu, As
122	Bradley Brook	Au, Ag, As, Pb
151	Mt. Costigan	Zn, Pb, Ag, Au
155	Indian Brook	Au, Cu, Zn
157	Quagus Stream	Au, Ag, Cu, As
159	Gold Brook	Au, Cu, As
160	Meridian Brook	Au, Ag, Pb
161	St. Michel	Au
170	North Nigadoo	Au, Ag

OTHERS

148	Madran (Hickey)	Au, Cu, Zn, Ag (disseminated sulphides in skarn)
156	Renous Road	Au (disseminated pyrite in Devonian rhyolite)
162	Tidley Mountain	Au (disseminated pyrite in Devonian rhyolite)
164	Shingle Gulch	Au (in Devonian rhyolite)
168	Upsalquitch (Smith)	Au (vein ?)
169	Alcida (Lacana)	Au

LEGEND

JURASSIC

Jm — diabase

PENNSYLVANIAN

Ps — Sedimentary rocks

MISSISSIPPIAN

Ms — Sedimentary rocks

DEVONIAN

Df — Granitic rocks
Dfv — Felsic volcanic rocks
Dmv — Mafic volcanic rocks
Ds — Sedimentary rocks

SILURIAN

Sfv — Felsic volcanic rocks
Smv — Mafic volcanic rocks
Ss — Sedimentary rocks

ORDOVICIAN - SILURIAN

OSs — Sedimentary rocks

ORDOVICIAN

Of — Metagranite
Omv — Mafic volcanic rocks
Ofv — Felsic volcanic rocks
Os — Sedimentary rocks (g-Grog Brook, t-Tetagouche, e-Elmtree Group)

GOLD OCCURRENCES

- ● — Gold in massive sulphide deposits (production from gossan of No3 & No4)
- ✎ — Quartz-sulphide (carbonate) veins (trend shown)
- ✦ — Quartz-sulphide (carbonate) veins (trend unknown)
- o — Gold in disseminated sulphides in devonian rhyolite
- ▪ — Disseminated sulphides in skarn
- ▲ — Alluvial gold

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1985 field work by Greg Philpott and Alex Campbell.

GOLD OCCURRENCES IN NORTHERN N.B. (J.L. Davies)

Introduction

The search for gold has long been part of folklore from many parts of the world, and northern N.B. is no exception. Gold occurrences were mentioned by Nicholas Denys in the 1600s, and were the subjects of many tales later on in the 1800s. Early workers such as R.W. Bailey, H.Y. Hind and R.W. Ells reported gold discoveries in the region, however, none have proved to be of economic importance. These early discoveries were either placers or associated with quartz veins, and most were found within the Tobique and SW-NW Miramichi watersheds (Figure 7). In the period from 1930 to 1950, prospecting in northeastern N.B. led to the discovery of several auriferous veins, but again they were not rich enough to warrant exploitation.

The discovery of large deposits of Zn-Pb-Ag-Cu sulphide deposits in 1952 marked the next chapter in the history of gold in northern New Brunswick. Although the value of gold at that time precluded its exploitation, routine assays showed that substantial amounts of gold were tied up in the massive sulphide deposits. The first production of gold from northern N.B. appears to have been in 1957. According to the Mines Branch annual report for that year, Heath Steele concentrates contained 240 ounces of gold.

Types of Deposits

The principal types of gold deposits reported in northern N.B. are;

(1) Quartz (± carbonate) veins with or without sulphide minerals

(2) Alluvial deposits

(3) Massive Zn-Pb-Ag-Cu sulphide deposits and their gossans

(4) Disseminated sulphides with gold in Devonian rhyolitic volcanic rocks.

Quartz vein deposits have been reported over a large area of northern New Brunswick, cutting rocks ranging in age from Ordovician to Devonian. Most of the veins are reported to be northwesterly to northerly trending and steeply dipping. It is interesting that no older deformed quartz veins are among the occurrences. Hence all these veins seem to be tension structures related to major northeasterly trending strike-slip faults, and late stage Devonian plutonism. Some seem to be related to porphyry copper-type mineralization.

The most obvious cluster of occurrences lies in an area northwest of Bathurst between the Rocky Brook-Millstream Fault and a northerly trending fault along the west margin of the Antinouri Lake granite stock. In this region the veins generally trend northwest, but with varying trends in places, they seem to be fillings of fractures related to late wrench movement on the Rocky Brook-Millstream Fault. The occurrences found so far lie within contact metamorphic aureoles surrounding granitic plutons. Associated minerals include pyrite, arsenopyrite, galena, chalcopyrite, sphalerite and pyrrhotite.

Spectacular assays have been reported occasionally from some of these veins, e.g. a 38 cm chip sample from Bradley Brook (Zarina) vein (occurrence no. 105), assayed 32 oz/ton Au and 18.6 oz/ton Ag, and a bulk sample assayed 18.6 oz/ton Au and 53 oz/ton Ag. At depth, however, drilling revealed only 0.01 to 0.02 oz/ton Au over 15 cm. Several other examples indicate that substantial enrichment of Au and Ag has occurred in the weathered zone.

The most recent gold discovery by Lacana Mining Corporation (no. 169) is in the Alcida-Madran area, along the faulted unconformable contact between the Ordovician Elmtree Group and the Silurian Chaleurs Group. Latest reports describe auriferous zones 200 m long and up to 10 metres wide. Channel samples from trenches have yielded assays of 0.104 oz/ton over 1.6 m, and 0.224 oz/ton over 9 metres. The exact nature of the gold mineralization

is not known, but the zone has a gossan, and associated minerals include pyrite, sphalerite and galena with appreciable silver.

The other discovery that has caused some excitement is in the Upsalquitch River area (occurrence no. 168) some 50 km west-southwest of the Alcida-Madran area. This showing is in folded Silurian siltstone and limestone and is intruded by mafic dykes and/or sills, associated with a prominent northeasterly trending fault, one of several splays of the Rocky Brook-Millstream Fault. Probable alteration and weathering obscures the nature of the mineralization, however, ubiquitous fine-grained disseminated pyrite, and hematite-pyrite veining seem to be controlling features.

Claim staking is now extending east and west and will no doubt cover the entire Rocky Brook-Millstream Fault zone from the Baie de Chaleur to the Southeast Upsalquitch River.

Alluvial occurrences of gold are among the earliest to be reported, however, many of these have been impossible to locate from the earlier descriptions. Almost all the reports of alluvial gold came from the upper reaches of the Tobique and Southwest-Northwest Miramichi watersheds.

By far the most important gold deposits are the Ordovician Zn-Pb-Ag-Cu massive sulphide deposits of the Miramichi zone. The average gold content of Zn-Pb-Ag-Cu ores ranges from 100 to 5000 ppb, or 10^2 to 10^3 times the crustal average. Gold is also significantly enriched in the stratigraphic footwall rocks of these deposits. In general, Au content is higher in the Zn-Pb-rich parts of the massive sulphide deposits, however, Heath Steele copper concentrates generally grade 0.115 to 0.8 oz/ton Au, whereas lead concentrates assay 0.03 to 0.036 oz/ton. The form of gold in these deposits is not known for certain, although electrum has been reported in the Caribou deposit (no. 3, Figure 7). Anaconda Canada has reported an average content of gold in its Caribou deposit as 0.02 oz/ton (reserves 30,000,000 tons) whereas the Kennco Murray Brook deposit (no. 10) grades 0.011 to 0.016 oz/ton gold. No figures are available from the Brunswick deposits (nos. 1 and 2), but it is likely that their grades are similar. Concentrates produced from the Wedge deposit (no. 5) from 1962 to 1968 contained 2200 ounces of gold. The gossans capping these deposits are greatly enriched in gold and silver. These minerals have been exploited in the Caribou gossan by cyanide heap leaching. Heath Steele has extracted approximately 25,000 ounces from 160,000 tonnes of gossan (grade 0.16 oz/tonne).

In 1985 Northumberland Mines Limited optioned the Murray Brook deposit, and at time of writing (October 1985) was drilling a series of holes to assess the extent and grade of gold and silver in the gossan.

Other potential environments in which gold might be expected include:

(1) Hemlo-type deposits within the Ordovician felsic pile of the Miramichi Zone, or in Silurian-Devonian volcanic assemblages in the Tobique-Chaleur Zone.

(2) Silurian and Devonian carbonate rocks near volcanic centres and/or large fault systems.

(3) Fossil placer deposits in Silurian, Devonian or Carboniferous rocks flanking the Miramichi Zone.

GEOCHEMISTRY OF GOLD IN THE TETAGOUCHE GROUP (J.A. MacIntosh)

This project was begun in 1985 to gather basic information on gold contents of a variety of rocks underlying northern New Brunswick. The initial work involving the Ordovician Tetagouche Group, was carried out by (1) compiling assays from assessment work files and (2) examining, sampling and assaying drill core stored at the Bathurst Regional Office (mainly from NTS 21 O/8, 21 P/5, and 21 O/9).

The core selected for analysis was chosen on the basis of pyrite-pyrrhotite content, however, some quartz veins were also assayed. The carbonate content of the sample was also a criterion. One hundred and twenty-two samples were assayed for Au and As. The results of this work will be released later in 1985.

SULPHIDE DEPOSIT STUDY

THE STRATMAT AND HEATH STEELE N-5 SULPHIDE DEPOSITS, NORTHUMBERLAND COUNTY, NEW BRUNSWICK (R.R. Irrinki and G.W. Crouse)

The Stratmat and Heath Steele N-5 deposits are the first to be evaluated as part of a more extensive sulphide deposit study being compiled for northern New Brunswick. The Stratmat deposit comprises five sulphide deposits: Stratmat East (Main Zone), Stratmat Central Zone, Stratmat West Zone A, Stratmat West Zone B, and Stratmat Stringer Zone. The nearby N-5 or Boundary Zone is closely related to the west zones, but is owned by Heath Steele Mines Limited.

Diamond drill holes of the Stratmat deposit as a whole were plotted on a 1 inch to 400 feet topographic map showing the various grid lines and mining licence boundaries. Diamond drill hole plans with sulphide intersections, cross-sections and longitudinal sections were drawn for each of the zones. Representative drill core samples were collected from the N-5 zone. A confidential report containing history, ownership, geology, tonnage calculations, concentration tests and recommendations was written for use within the Department.

The massive banded sulphides consist of fine- to medium-grained interbanded sphalerite-galena and pyrite, with local coarse-grained chalcopyrite hosted by argillite. Vaguely banded pyrite-chalcopyrite occurs locally. Disseminated grains and stringers of medium-grained pyrite and/or sphalerite with smaller amounts of galena and chalcopyrite occur in argillite and felsic tuff. The sulphide deposits and their host argillite are sandwiched between two polydeformed sequences of felsic crystal and lapilli tuffs ("Southwall and Northwall sequences"). One large gabbro dyke and several diabase dykes cut the supracrustal rocks of the Stratmat East Zone. All rocks are thought to be Middle Ordovician in age (Tetagouche Group). The shapes and attitudes of the sulphide-bearing zones are controlled by two sets of folds.

DRILL CORE MANAGEMENT PROJECT

Greg Crouse, Core Librarian

The ever-increasing amount of drill core being stored in Provincial Repositories necessitated the appointment of a Core Librarian and the implementation of a Core Storage Policy. This policy, which is presently being developed, will establish guidelines for the Regional Geologists and Core Librarian on the acceptance, storage and abbreviation of drill core.

An inventory has been made of drill core stored in Fredericton and Sussex repositories and records are being computerized to facilitate updating. Records are to be cross-referenced by company name and by storage location. The records will include: Company name, property name, NTS location, latitude and longitude, elevation, date drilled, date submitted, depth of overburden, length of hole, number of boxes, length stored on racks, location of core, condition of core, availability and location of other data pertaining to the hole. Floor plans of repositories indicating storage locations and base maps indicating drill hole locations are to be produced.

GEOLOGY AND GEOCHEMISTRY

AMPHIBOLITES OF THE MIRAMICHI HIGHLANDS (L.R. Fyffe, Regional Geologist)

Amphibolites, associated with migmatitic sedimentary rocks in the Miramichi Highlands of central New Brunswick, have been variously interpreted to be Precambrian or Cambro-Ordovician in age. A detailed study of several well-exposed sections is being made in order to better document field relationships between these rocks and those of known Ordovician age.

The presence of Precambrian rocks in central New Brunswick has long been suspected, but has not as yet been confirmed. The Trousers Lake Complex comprises a sequence of interlayered amphibolite, mica schist, psammite and fine-grained granite gneiss that is quite unlike the volcanic and sedimentary rocks of the Ordovician Tetagouche Group. Rocks of the complex can be traced southward from Trousers Lake to the Catamaran Fault, but their eastward extent is not known with certainty. Similar rocks occur south of the Catamaran Fault in the Sisson Brook area where they appear to be in fault contact to the southeast with quartzite and phyllite of the Tetagouche Group (Figure 8).

Samples of the distinctive amphibolite from the Trousers Lake Complex have been collected in various areas for chemical and radiometric studies. The chemical analyses should determine whether the protolith of the amphibolite was a limy sedimentary or a mafic igneous rock. The possibility that the amphibolites are high-grade metamorphic equivalents of mafic volcanics of the Tetagouche Group will be examined by comparing their respective trace element chemistry. Argon-argon ages on hornblende separates will be used to establish metamorphic ages and cooling history of the complex.

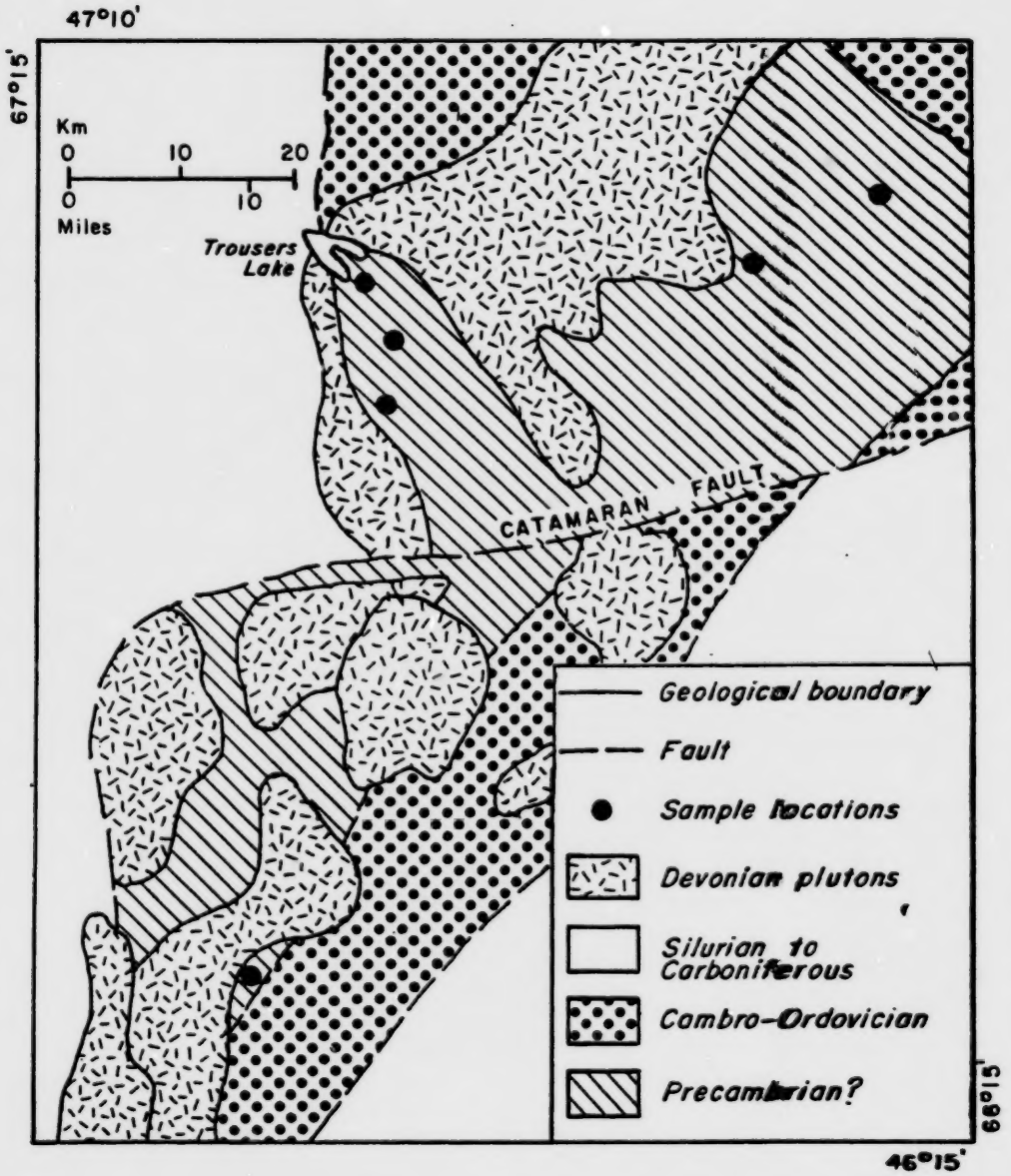

Figure 8. Geology map of central New Brunswick

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A PETROCHEMICAL AND METALLOGENIC INVESTIGATION OF GRANITES IN THE BURNTHILL-DUNGARVON AREA OF CENTRAL NEW BRUNSWICK (H. Elizabeth MacLellan, Project Geologist)

The objective of the Burnthill project within central New Brunswick is to determine the petrochemical evolution of the Late Devonian-Mississippian granites and associated tin-tungsten mineralization in order to develop criteria that will aid exploration for similar types of deposits. The project began in June, 1985 and will require 3 to 5 years to bring to completion. The work this summer concentrated on field mapping of the Burnthill Granite. Richard Taylor of Carleton University, the consulting geochemist for the project, joined the field crew for four weeks to direct the examination and sampling of several of the mineralized showings.

Several granitic phases have been outlined on the preliminary map of the Burnthill Granite (Figure 9). Units 1 and 2 comprise the various igneous and sedimentary country rocks. The main phase of the Burnthill Granite (Unit 3) contains a variety of textural variants, three of which are shown as mappable units; these phases are considered to be comagmatic. A fine medium-grained, porphyritic biotite granite (Unit 3a) occurs along the margin of the granite and is considered to be a chilled border phase of Unit 3b; it also occurs locally within the granite, suggesting proximity to the roof. Medium- to coarse-grained, subporphyritic to porphyritic biotite granite (Unit 3b) forms the bulk off the granite pluton. This rock fines somewhat from north to south and, in proximity to Unit 4a, is primarily distinguished by its phenocrysts and/or the seriate texture of its groundmass. Relatively late, dyke-like bodies of porphyritic microgranite and aplite (Unit 3c) contain variable proportions of quartz, alkali feldspar, plagioclase and biotite phenocrysts. They are distinguished from Unit 3a by lower biotite contents, the presence of muscovite, finer-grained groundmass, and generally lower proportions of phenocrysts.

Unit 4a is a medium-grained, equigranular biotite-muscovite granite. The finer-grained biotite-muscovite granite of Unit 4b is closely associated with the Burnthill Tungsten Mine. The rocks of Unit 4 (a,b) appear to be younger than those of Unit 3, based on outcrop distribution. The general paucity of large alkali feldspar phenocrysts in Unit 4, as compared to Unit 3, suggests that it represents either a separate and later intrusive event, or an area within the magma chamber where fluids were concentrated, thereby inhibiting early crystallization. The youngest intrusive phase known within the Burnthill Granite is a porphyritic biotite granodiorite (Unit 5), which contains inclusions of Units 4a.

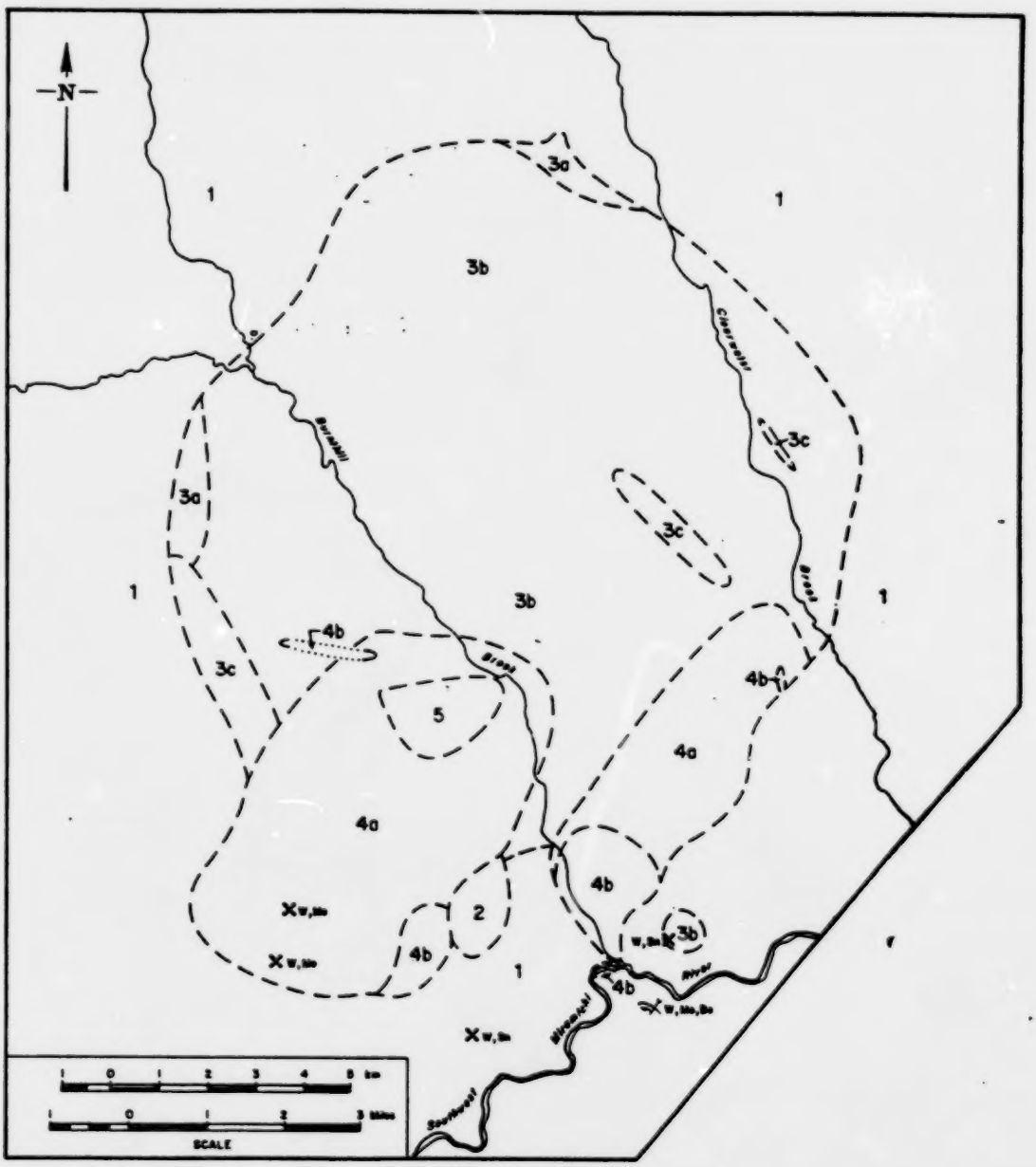

Figure 9. Preliminary map of the Burnthill Granite

(Legend follows)

LEGEND

LATE DEVONIAN-MISSISSIPPIAN

5	Fine, medium-grained porphyritic biotite (15%) granodiorite
4b	Fine-grained biotite (5%)-muscovite (2%) granite; locally porphyritic
4a	Medium-grained, equigranular biotite (5-7%) granite; minor muscovite; locally porphyritic
3c	Porphyritic microgranite and associated aplite; 5% biotite and muscovite
3b	Medium- to coarse-grained subporphyritic to porphyritic biotite (8-10%) granite
3a	Fine, medium-grained porphyritic biotite (8-10%) granite

LOWER DEVONIAN

2	Massive to weakly foliated, subophitic gabbro

LOWER DEVONIAN AND OLDER

1	Country rocks including Devonian and Ordovician granites and Cambro-Ordovician metasediments and metavolcanics of the Tetagouche Group

SYMBOLS

——— Geological boundary

× Metallic mineral prospect, mine workings, tungsten (W), tin (Sn), molybdenum (Mo), beryllium (Be)

Several mineral occurrences, representing a spectrum of tin-tungsten mineralization in the Burnthill-Dungarvon area, have been visited and sampled for preliminary petrographic studies. The Todd Mountain and McLean Brook showings are sediment-hosted, quartz swarm deposits located south of the Burnthill and Trout Brook Granites, respectively. The Burnthill deposit is a sediment-hosted quartz vein swarm that passes into a granite-hosted, greisen-bordered vein system at depth. Access to the Burnthill Brook deposit core, drilled by Miramichi Lumber Co., has been provided by the company geologist, Russell Crosby. The Tin Hill showing is a tin-tungsten-bearing quartz vein system with associated greisen alteration occurring in a cupola of the Burnthill Granite at Buttermilk Brook. The Sulpetro and Dungarvon showings are cassiterite-bearing quartz and feldspar vein systems with associated feldspathization, occurring in the Dungarvon Granite.

Petrography of the granites, and ore and alteration minerals in the showings will be examined during the remainder of the project year. A systematic program of $^{40}Ar/^{39}Ar$ age dating on K-rich phyllosilicates from the granites and alteration zones associated with mineralization has been initiated. This will be accompanied by fluid inclusion and stable isotope studies of the mineral deposits.

SURFICIAL GEOLOGY AND GEOCHEMISTRY OF THE TETAGOUCHE LAKES MAP SHEET (21 O/9) (A.G. Pronk)

The surficial deposits in the Tetagouche Lakes area are mainly tills with minor glaciofluvial outwash and ice-contact deposits. Most of these glaciofluvial deposits have limited areal extent and do not appear on Figure 10.

The tills in the area are closely related to local bedrock, though components have been transported from as far as 20 km in the up-ice direction. Where tills overlying bedrock are thin, they tend to be coarse with local bedrock components as major elements. Where tills are thicker, they tend to be fining upwards and more distal components are present in the upper part of the till. Tills derived from the sedimentary bedrock are finer than those mainly derived from felsic volcanic bedrock. The complexity of the bedrock geology is reflected in the till composition.

Ice movement, recorded from approximately 150 striae sites, has taken place in an easterly direction (80°-110°), followed locally by north to northeasterly and southeasterly movements (Figure 10). The first and main movement modified most east-west-oriented valleys into U-shaped profiles, whereas the north-south-oriented valleys are generally V-shaped and unmodified.

The easterly ice movement is not detected in any till fabrics. Pebble orientations reflecting the later movements reveal an ice movement of 50° to 70°. Either the easterly movement was mainly an eroding one and deposition took place during a later phase (when the thermal regime at the base of the ice allowed material to be released and basal till to be deposited), or tills with an easterly fabric are all buried.

Ae-, B- and C-horizon samples of the surficial materials were taken on a 2 km grid at 266 sites for geochemistry and till composition. Several roadcuts exposed thick till and were also sampled.

A soil geochemistry compilation was made of all available data in assessment files, and will be compared with the till geochemistry data. The surficial geology map will contain information on texture, lithology, thickness and genesis of the surficial deposits.

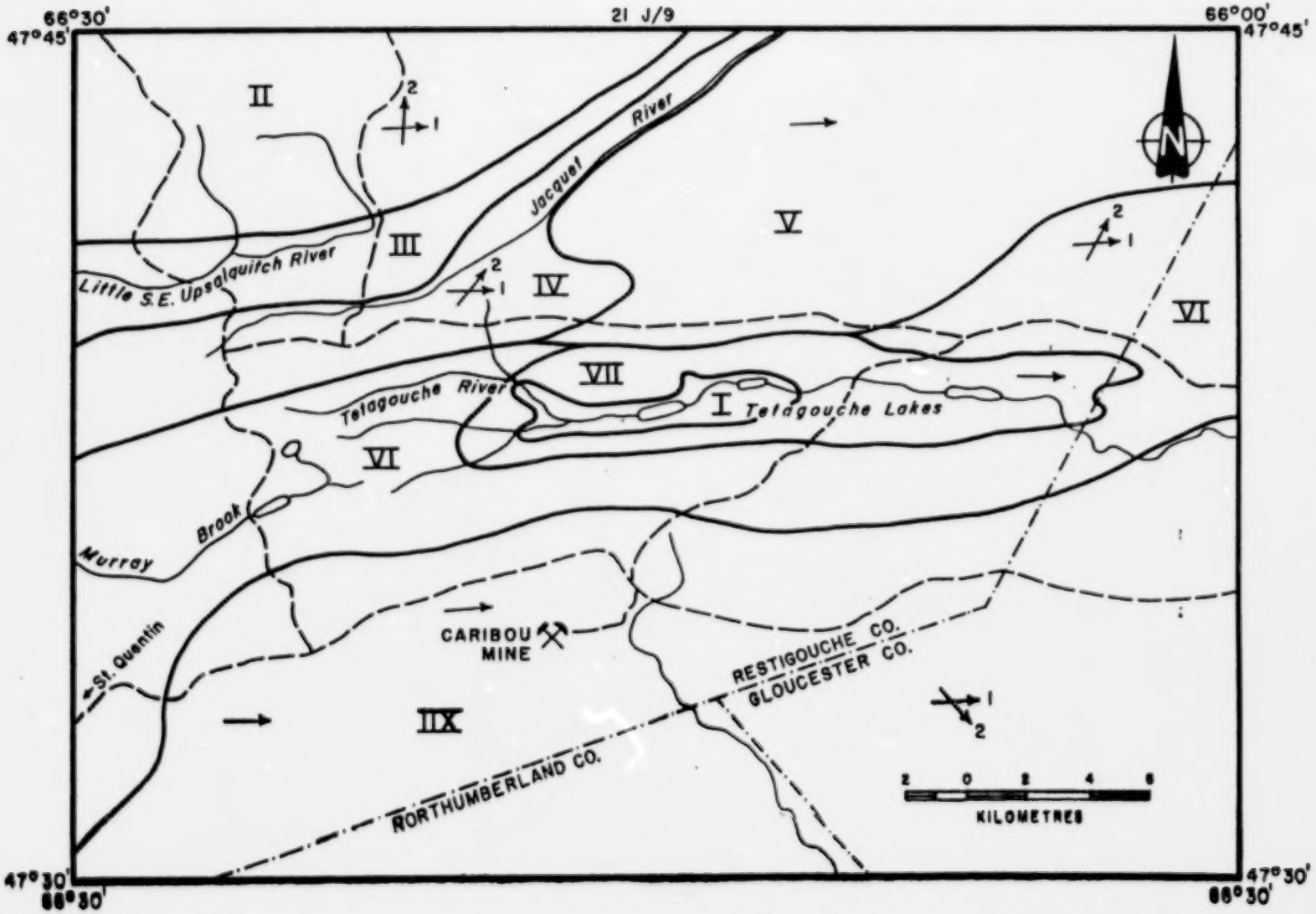

Figure 10. Simplified surficial geology of the Tetagouche Lakes Map Sheet

LEGEND

I	Glacial outwash over red till
II	Olive-brown, stoney till (< 1 m thick) mainly felsic components
III	Olive-brown, coarse sandy till (< 1 m thick) mostly sedimentary, some felsic components
IV	Olive-brown, coarse sandy till veneer, mostly felsic volcanic, some sedimentary components with patches of bedrock and broken bedrock
V	Olive-brown, fine sandy till with patches of bedrock, generally thin
VI	Dark brown to reddish brown, sandy till, mainly sedimentary, some felsic components
VII	Red, fine sandy till, mainly sedimentary clasts (>1 m thick)
VIII	Yellowish brown, coarse sandy and stoney till (felsic volcanic and sedimentary components)

SYMBOLS

→	Ice flow directions
⌒	Main roads
—	Geological boundaries

GEOSCIENCE DATA CENTRE

D.J.J. Carroll

The year 1985 was one of increasing activity for the staff of the Geoscience Data Centre. Refer to Figure 11 for Organization Chart. One of the main reasons for this increase is that the GDC became heavily involved in the Federal-Provincial Mineral Development Agreement, especially the Public Awareness Program. Other contributing factors include an increase in public/industry requests for geoscientific data and the development of better accounting procedures for geoscientific data dissemination. In order to provide some insight into the 1985 activities of the GDC, a brief synopsis of the major projects is described below.

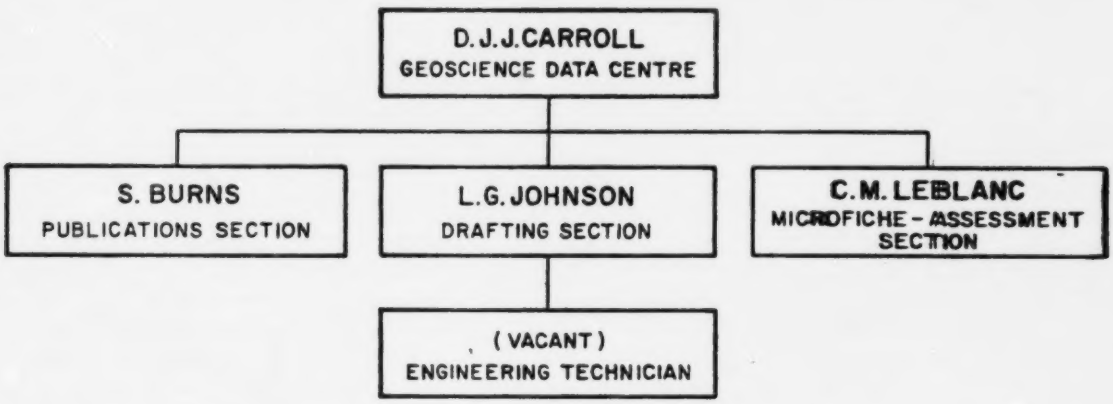

Figure 11. Organization Chart of the Geoscience Data Centre

PROSPECTING COURSES

The start of the 1985 calendar year commenced with the Geoscience Data Centre once again offering Introductory Prospecting Courses during the first quarter. The centres where the courses were taught included Fredericton, Saint John, and Moncton. In all, a total of 52 people registered for these sessions.

As in previous years, the participants of this course were offered a field trip by Dr. A.A. Ruitenberg, Regional Geologist for southern New Brunswick. This year's trip included the Cape Spencer and Little Dipper Harbour areas. A total of thirteen people participated in this activity.

Due to a large number of requests from participants of the Introductory Prospecting Course for more advanced and field-related training, the Geoscience Data Centre, under the 1985-86

MDA Public Awareness Program, commissioned the writing of a series of Advanced Prospecting Course curriculum notes.

After reviewing what literature and course-related material was available from other provinces, a six-session Advanced Prospecting Course was prepared that incorporated both classroom instruction and field-related activities.

The Advanced Prospecting Course began in October when eighteen people registered for the course which is being taught in Sussex. The first two sessions that were held concentrated on traversing and claim-staking procedures.

Another MDA project that commenced recently is the production of a video film concerning the field of prospecting and mineral exploration. Most of this year's work will involve filming the activities of the participants of the Advanced Prospecting Course. This project, which will probably involve two seasons of production, will also attempt to highlight the rights of the prospector versus that of the individual landowner.

PUBLIC AWARENESS ACTIVITIES

Displays

In order to increase the public profile of the Mineral Resources Division's activities and the mineral industry of New Brunswick, two new display exhibits were produced in 1985.

The first display, which was produced in-house, was designed to highlight the 1984 exploration activity in the southern and northern parts of the province. In addition, the exhibit portrayed the work that was carried out in the Trousers Lake area where several scientific agencies were involved with various surveys around the earthquake site.

This display was part of the Department's Geological Surveys Branch annual contribution to the Provincial Geologist's display area that has been reserved for the past few years at the annual Prospectors and Developers Convention in Toronto. Senior staff from the Sussex and Bathurst Regional Offices were on hand at the display to answer people's enquiries.

The second exhibit was produced under the Mineral Development Agreement and funded both by the Department of Natural Resources and Energy, Mines and Resources Canada.

This display unit, which also was utilized at the 1985 P & D in Toronto, was designed to indicate to the mining and mineral exploration industry, what projects were to be conducted under the MDA in 1985 and where these were centred.

The MDA exhibit was used several times after its inauguration at the P & D, namely at the GAC/MAC Annual Meeting (held this past May in Fredericton), the Beresford Industrial Trade Show in June, and the lobby of the Centennial Building in Fredericton.

The previously produced Mining Display was exhibited at the 10th Annual Meeting of the Canadian Cartographic Association held at the University of New Brunswick, Fredericton, in June.

Audio/Visual Aids, Publications, Presentations

One of the main tasks associated with the MDA Public Awareness Programs is to publicize, through the use of identification means, the various publications, displays and similar materials that will be produced during the course of the agreement.

In order to accomplish this task, a logo was produced as one means to publicly identify these products and programs. Mr. R.E. Phillips of the Geoscience Data Centre, designed such a logo that reflected geological and mineral industry connotations. This symbol was introduced publicly at the 1985 Prospectors and Developers Convention in Toronto where it formed part of the MDA display.

Another 1985 MDA project involved the purchase of appropriate photographic slide storage facilities to house the increasing number of mineral industry and geoscience-related photos. Since it is anticipated that photographic images of every nature will form an important part of the Public Awareness Program under the MDA and the Mineral Resources Division's own information awareness activities, efforts were begun to systematically catalogue all presently existing photographic images within the confines of the Geoscientific Data Centre. Each year, not only are these images utilized internally, but several requests from government departments, industry, and trade journals/newspapers are received for the use of photographic images related to the mineral industry of New Brunswick.

One publication which was publicly released at the GAC/MAC Annual Meeting in May and that deserves special attention is the "Geological Highway Map of New Brunswick and Prince Edward Island". The production of this map was spearheaded by the Atlantic Geoscience Society, involved several months of work by members of that Society, the staff of the Mineral Development and Geological Surveys Branches of the N.B. Department of Natural Resources, and the University of New Brunswick as well as other people. Funding for the production work involved in this project came from several organizations while printing of the map was accomplished through the MDA and was funded by Energy, Mines, and Resources Canada.

Notwithstanding the public awareness materials mentioned above, the Geoscience Data Centre is still receiving several requests throughout the year for the film entitled 'The Awakening Giant', and the 35 mm slide show 'The Mineral Industries of New Brunswick', programs that were produced under the last Federal-Provincial General Development Agreement.

In an effort to assist education instructors with mineral resource and geoscientific subjects, several schools in the Fredericton area were visited and lectures given. In addition, a presentation on the educational materials related to geology and mining, and available to school teachers, was given at a teachers workshop in Saint John held in May.

ON-GOING ACTIVITIES

Mineral Exploration Assessment Reports

To date 68 assessment reports have been received during the current year. These reports have been indexed for entry into the Geological Survey of Canada's bibliographic data base called GEOSCAN. An index to 1984-85 assessment reports will be produced for handing out at this year's Review of Activities.

Concerning microfilming, the Geoscience Data Centre is continuing to have all incoming assessment reports filmed and each repository of our microfiche information updated with this new data.

Publications

The publications section of the GDC plays an important part in the dissemination of geoscientific data produced by the Mineral Resources Division for public and exploration industry use. For the period January-October 1985, the map and publication sales totaled approximately $18,000.00.

In order to provide assistance to the users of our geoscientific data, especially our report and map publications, the GDC has increased the indexing activity of these documents for inclusion into our ever-increasing bibliographic data base with GEOSCAN. Approximately 85% of the report document category has been coded and entered into that data base. Intentions are to produce custom indexes similar to the annual assessment data index when all the reports have been indexed.

One major project undertaken this year related to the matter of more appropriate accounting procedures involved with the dissemination of geoscience data from the Geological Survey Branch offices. One aim of this project was to use this information to get a better handle on the number of individual reports that

should be printed, since storage space for publications and related public information remains at a premium. Only by properly recording the sales and dissemination of published data will one be able to accomplish this task.

To monitor this document flow in a more mechanized and high technology fashion, the provincial government computer centre was contacted for assistance. Presently, the GDC is utilizing Mapper data base software and the mainframe computer to record the weekly transactions of the publication section of the GDC.

LIMESTONE INVESTIGATIONS

T.C. Webb

Most of New Brunswick's main resource-based industries are dependent to some degree on a reliable, nearby supply of limestone, dolomite or their products. Although, traditionally used as a soil conditioner in agriculture-related practices and as a source of aggregate, it is apparent that over the last 10 or 15 years, limestone, in the form of lime, has become an essential industrial chemical with a formidable list of uses. Indeed, limestone is probably one of the most useful and versatile of all the industrial mineral commodities produced in this province. In the past, the limestone industry has accounted for over 300 jobs for New Brunswickers as well as contributing over several million dollars annually to the value of mineral production within the province.

Since the 1965 publication of J.B. Hamilton's "Limestone in New Brunswick" there has been no concerted effort to update information on our provincial limestone resources with the exception of information scattered throughout various Mineral Resources Division files and reports and in company assessment files. Over the last 20 years, there have been a number of significant developments concerning the province's limestone industry - the expansion of Havelock Lime Works Ltd. into the field of quick and hydrated lime and the reopening of a quarry at Elmtree in northern New Brunswick are two examples. Various exploration programs for limestone have been undertaken both by government and private industry resulting in new occurrences being discovered as well as adding to a plethora of information concerning the evaluation of known deposits.

At this point in time, what is needed is an all-encompassing study involving a reexamination and reassessment of the province's limestone resources, as well as a report on the state of the industry within the province. A computerized information retrieval system containing important facts on individual deposits and occurrences is being undertaken. This has been augmented with field examination involving mapping, sampling and detailed descriptions of individual occurrences. A reference collection, consisting of over 800 hand specimens, chip and channel samples of various exposures throughout the province is in the process of being set up. A sample inventory containing information on samples from various deposits is being prepared. In addition, a catalogue of lithological and analytical drill hole data is also being compiled. This is being done with the intention of guiding those persons interested in deposits with special chemical or physical properties in specific areas.

In New Brunswick, the majority of our better quality limestones and dolomites are found principally in rocks of Precambrian, Silurian and Mississippian age, although a few occurrences have been recently noted in Ordovician rocks as well. To date, field reconnaissance of most of the main occurrences has been completed and data compilation on individual deposits has been accelerated.

Considering the vast amounts of information available, coupled with that more recently collected, this project has become a fairly massive undertaking, however, a final report is expected to be completed sometime in 1986. Upon completion, it will address such issues as the historical development and current status of the province's limestone industry, as well as various geologic aspects of our known deposits and occurrences. It is also intended to investigate various industrial applications of limestone along with specifications for these uses. A review of the current and future supply/demand situation for limestone in Atlantic Canada and the northeastern United States has been recently commissioned.

While providing a concise inventory of provincial limestone resources, it is hoped that this study will identify new development opportunities for existing and possible future New Brunswick producers and also act as an important guide, assuring the future protection of our existing, higher-quality deposits from the threats of urban expansion. These results combined, should ultimately result in better management of this important resource.

HYDROCARBON INVESTIGATIONS

A.T. Martel

Petroleum exploration in New Brunswick has increased dramatically since 1980. Hydrocarbon investigations underway are intended to produce a better understanding of the petroleum potential of the Province's sedimentary basins.

SEISMIC STRATIGRAPHY OF THE NEW BRUNSWICK CUMBERLAND SUBBASIN

Sedimentation in the New Brunswick portion of the Cumberland Subbasin was controlled by surrounding basement blocks. These blocks were intersected in drill holes at Westmorland (Westmorland Block), Port Elgin (Port Elgin Block) and Hastings (Hastings Block).

The stratigraphy is quite similar to that of the Moncton Subbasin as it contains the Horton Group (including the hydrocarbon-prone lacustrine rocks of the Albert Formation), Windsor and Hopewell Groups, the Boss Point Formation and the Pictou Group.

The thick, laterally extensive Horton section makes the Cumberland Subbasin a prime petroleum exploration target.

PETROLEUM POTENTIAL OF THE ESCUMINAC FORMATION

The Escuminac Formation is being studied for petroleum potential. Although the Escuminac only outcrops on the Quebec side of the Restigouche River, it probably underlies the Baies des Chaleurs and therefore, may have economic significance to New Brunswick.

The Formation was examined for the quality of its source (rocks from which petroleum originates) and the quality of its reservoir (rocks in which petroleum is trapped). Rock-Eval pyrolysis of the source rocks revealed that, although some rhythmite beds were organic-rich, most were below preferred levels.

Parameters detracting from the reservoir quality of the Escuminac sandstones are the fine grain size and heavy carbonate cement, while good sorting and bed thicknesses should enhance the reservoir potential. Companies should explore for coarse sand facies juxtaposed to areas of high organic activity.

HYDROCARBON SHOW MAP

The Hydrocarbon Show Map study examined all reported oil- and bitumen-impregnated rocks in the Province. Samples were studied in thin section and tested for "live oil" and in some cases for total organic carbon.

Data sheets for each showing will be available describing the outcrop, rock types, dominant clast lithologies, and evidence of hydrocarbons. A set of 1:50,000 maps identifying the type of show and the location will be published. Supplimentary data on provenance, porosity and diagenesis will be accessible at a later date.

ALBERT FORMATION OIL SHALE ASSESSMENT

Clint St. Peter

The Lower Carboniferous Albert Formation of southeastern New Brunswick was mapped by the Department during the summers of 1982, 1983, and 1984. The location of surface exposures of oil shale, and in particular, high-grade oil shale, was one of the major objectives of the mapping project. It has been found that promising oil shale beds crop out at Taylor Village, St. Joseph, Boudreau and Dover in Westmorland County, and at Albert Mines and Rosevale in Albert County. The discovery of encouraging oil shale exposures at Rosevale (Figure 12) and the determination that the shales may be amenable to open cut mining has led to the tendering of a geologic and economic assessment study. The assessment project is provincially funded under the Federal-Provincial Mineral Development Agreement, and it has been awarded to K.D.A. Whaley of Fredericton.

Initiation of the assessment project began in mid-September with the drilling of the first hole of a five hole program that will encompass 900 metres of NQ core. Borehole logging of the five holes is expected to be completed by early November. Core-splitting and assay work will be undertaken during the fall of 1985 and the final report is scheduled for submission before March 31, 1986. It is hoped that positive results from this study will lead to further evaluations and the encouragement industry requires to explore and develop the province's oil shales.

Further exploration of New Brunswick oil shales is an expected necessity. The New Brunswick Electric Power Commission is presently retrofitting their 20 megawatt thermal plant at Chatham to accommodate a circulating fluidized bed burner for the co-combustion of coal and oil shale. Albert oil shale has the capacity, by virtue of the carbonate minerals it contains, to almost completely remove the sulphur oxide gases generated during the combustion of New Brunswick's sulphur-bearing coal. If the Chatham plant yields the expected results from the co-combustion demonstration, there is the likelihood that other larger coal-burning stations may be similarly retrofitted. In this event, additional supplies of oil shale will be required. It is planned that the assessment now taking place at Rosevale will provide the necessary lead time to accommodate possible increased future oil shale supplies.

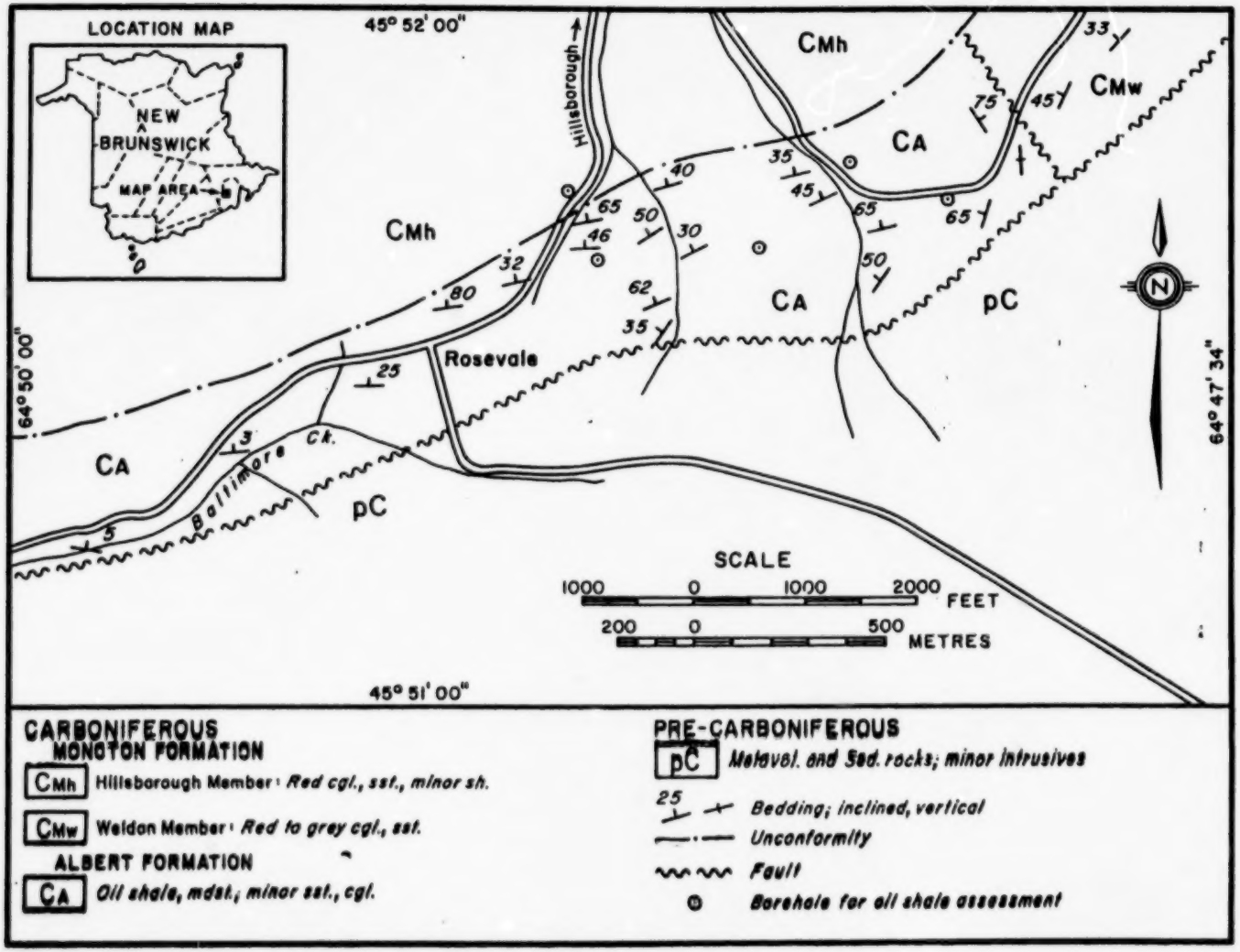

Figure 12. Generalized geology of Rosevale area, New Brunswick

MINING ENGINEERING & MINERAL ECONOMICS

J.J. Chandra

ECONOMIC STUDIES:

The fall in metal prices and lower world consumption patterns have created major problems for the mining industry as a whole. New Brunswick was not spared the effects of this decline which resulted in two casualties in New Brunswick; Heath Steele Mines Limited, and Mount Pleasant Tungsten Mine. In addition, our chance of ever seeing a zinc smelter in New Brunswick grows dimmer. Metal consumption has fallen worldwide when compared to the growth rates of the Growth Domestic Product in most countries. To compound the problem, the Metals Mining Deflator Index has risen over 300% since 1971. A miner's dollar in 1972 would require $3.48 in 1980. As a result, project financing has become very critical and it would appear that capital intensive mega projects are a thing of the past. How we recover from this dilemma is a challenge both to industry and to the government.

(i) Heath Steele Mines Limited:

A Task Force on Heath Steele Mines Limited was authorized by the Premier as a result of a request by the United Steel Workers Union. Its mandate was to investigate the feasibility of reopening the mine and to determine the contributions by the government, the union and Noranda which would make this possible. The Task Force met four times and concluded that the cost of reopening was too high when compared to the benefits it would provide to workers and to the province as a whole. The Department will continue to monitor the situation and will cooperate with Heath Steele Mines Limited on a joint mapping program of the B Zone.

An in-house economic analysis of Heath Steele Mines Limited was also completed. This study looked at the history of the mine, its production and financial performance and the feasibility of future operation. As part of this study, detailed analyses of the future of zinc, copper, lead, silver and gold were undertaken. While the main report is not available to the public, copies of the metal reviews can be obtained from the author.

(ii) Zinc Smelter Study:

An economic feasibility study on a proposed New Brunswick Zinc Smelter has been completed. This study was accomplished jointly with the Department of Commerce and Development under an interdepartmental committee made up of D. Gemmell, E. Jagoe, G. Greer and J. Chandra. The interdepartmental committee's recommendations have been submitted to the Deputy Minister.

(iii) Mount Pleasant Tungsten Mine

An economic analysis of the Mount Pleasant Tungsten Mine has also been completed. World tungsten and molybdenum prices are the two main factors contributing to the demise of this joint venture between Billiton Canada Ltd. and Brunswick Tin Mines Ltd. It is our conclusion that there is still major potential in the Mount Pleasant region, in particular relating to the tin ore bodies at the North Zone deposit. In addition, the Mt. Pleasant Caldera complex is still not fully explored and there is every indication that other deposits exist nearby.

As part of this study, detailed analyses of the future of tungsten, tin and molybdenum were undertaken. While the main report is not available to the public, copies of the metal reviews can be obtained from the author.

(iv) New Brunswick Mineral Production Statistics 1956-1984

Mineral production data for the period 1956-1984 has been prepared as an Open File report which will be released by November 1985. This document contains listings of annual production figures for metals, non-metals, fuels and structural materials. Included are graphic plots for each commodity. Value statistics ($) are provided both in current and constant Can. 1984 $.

(v) Mineral-based manufacturing opportunities in New Brunswick

The basic metallic and non-metallic minerals produced in New Brunswick have many uses. The purpose of this report is to:

(1) Identify the metals, minerals and rocks currently produced in N.B. and those with potential for production.

(2) Identify the basic saleable forms of each metal, mineral or rock produced with approximate percentages.

(3) Outline the various uses for each basic form.

(4) Outline possible mineral-based manufacturing opportunities for the various forms of the basic metallic and non-metallic mineral resources produced in New Brunswick.

This Open File report will be ready for release by November, 1985.

ENGINEERING STUDIES:

(i) Miramichi Earthquake Studies

A cooperative study undertaken at the Indian Lake site in 1983-1984 by EMR, DNR and Ontario Hydro was completed in 1985. This study involved the measurement of regional and local stress by the over-coring method. Results of the study are contained in a report entitled "In-situ stress pilot project - Miramichi Epicentral Area" published by Ontario Hydro (Report No. 85-185-K).

Aftershock activity at the Miramichi site is still being monitored by EMR. The frequency of aftershocks is diminishing as shown in Figure 13.

(ii) Salt Backfill in Potash Mines

This project is funded under the Canada-New Brunswick Mineral Development Subsidiary Agreement. New Brunswick mines are required to place waste salt in mined-out openings to reduce storage on surface. If properly stowed, backfill will reduce absolute convergence and improve stability of adjacent mine openings. However, the beneficial effect of backfill on mine stability is only partially known. Therefore, field and laboratory investigations in connection with numerical modelling are required to quantify the beneficial effect of backfilling on mine stability.

A Requisition For Services (RFS) was put out by the Federal Department of Supplies and Services on May 1, 1985 for this project. The statement of required work is as follows:

1. Determine the strength and deformation properties for waste salt as backfill under steady state creep conditions. The load range and rate should cover the compression expected from wall pressures due to excavation convergence.

2. Carry out field tests to identify convergence rate and magnitude of relevant mine openings to verify the criteria under 1.

3. Determine potential packing densities of waste backfill achieved by various types of stowing.

4. Determine the engineering properties of the materials in roof, floor and pillars necessary for numerical or mathematical modelling as required in item 5.

5. Carry out a numerical or mathematical analysis to show the stabilizing effect of backfill on single openings in evaporite strata of relevant mining depth in New Brunswick.

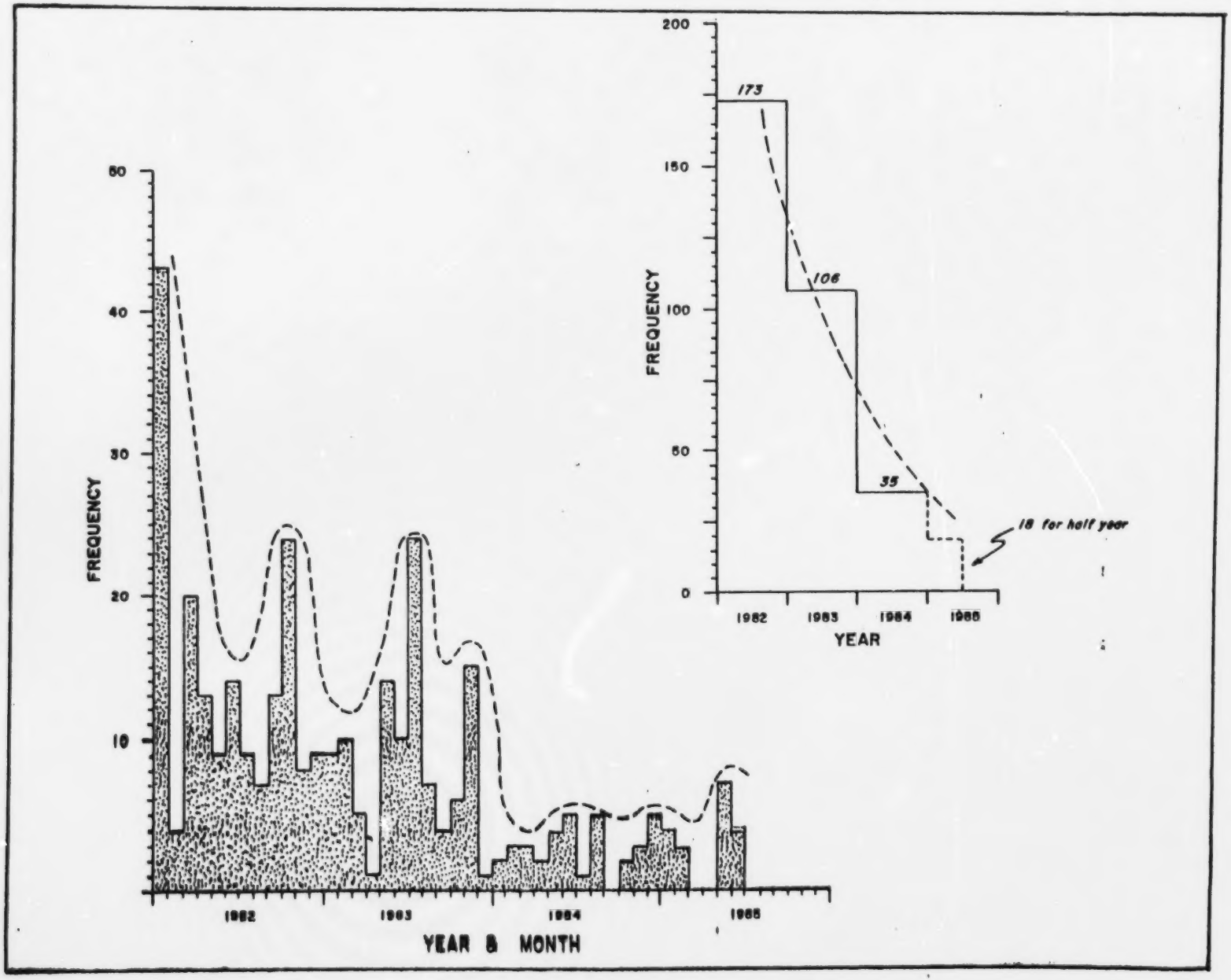

Figure 13. Aftershock sequence of the Jan. 9, 1982 Miramichi N.B. Earthquake (Mn. 5.7)

6. The analysis performed should have the potential to be expanded to multiple openings or model a complete mining layout. This work may be authorized as an optional item to this contract.

7. Outline the scope, schedule and funding requirements of a field demonstration to prove the stabilizing effect of waste salt backfill (reduced absolute convergence and convergence rates). The anticipated effort for such a field demonstration could include an instrumented backfilled room which would be observed for a period of one year.

Responses to this RFS were appraised by EMR and DNR and by mutual consent, a contract was let to the joint group of Mraz Project Consultants Ltd. and University of Waterloo. The project work will be undertaken at the Denison Potacan Potash Company mine at Sussex. Work will begin shortly and will be monitored by EMR and DNR.

(iii) Mactaquac Head Pond Project: Undertaken with the assistance of the UNB Department of Surveying Engineering, Drs. R. Yazdani and E. Derenyi.

Analysis of gravimetric, geodetic and thematic data (Earth Resource Satellite Images) of the Mactaquac Head Pond area is being undertaken to locate all structural features in the region which may be causative of rock creep and local uplift.

SPONSORED STUDIES

Two studies have been sponsored at the University of New Brunswick to allow students to research subjects related to the mining industry and which could be used as course or thesis material. They would also be of value to the Mineral Resources Branch.

(1) Title: Economic Heavy Minerals in selected placer deposits of N.B.
A geologic and mineral resource utilization appraisal.

Supervisors: E. Hale, J. Chandra
Objectives: Primary objectives of the proposed study are to establish the nature of heavy mineral occurrences in the province and their constituent makeup, and to establish the feasibility of fitting the said deposits into various exploitation models. Base exploitation systems/models will be evaluated with flowsheet descriptions and marketing and economic impact considerations.

(2) **Title: Preliminary assessment of the use of colour infrared aerial photography for monitoring environmental effects of strip-mining. Minto Area, New Brunswick.**

Supervisors: S. Oliver, J. Chandra
Objectives: This project attempts to test the detectability of environmental impacts of strip-mining in the Minto-Chipman area. Hand-held colour infrared and low attitude oblique aerial infrared photographs will be acquired over selected sites and analysed for recognition patterns relating to acidity in ponds and to vegetative growth rates.

PUBLICATIONS

Chandra, J.J., Yazdani, R. and Devenyi, E. 1985. Assessment of data enhancement techniques in the mapping of linear structures. A case study in Southern New Brunswick Imternational Symposium on Remote Sensing of the Environment, 4th Thematic Conference, April 1-4, 1985. (Paper to be published in Proceedings).

Chandra, J.J. 1985. Geothermal Heat Potential of the Central Carboniferous Basin, New Brunswick. Paper presented at the "Geothermal Energy from Sedimentary Basins" Conference held at the Institute of Sedimentary and Petroleum Geology, Calgary, Alberta, November 20, 1985.

Chandra, J.J. In preparation. Mineral-based manufacturing opportunities in New Brunswick. Mineral Resources Division, Department of Natural Resources.

Chandra, J.J. In preparation. Mineral Production Statistics 1956-1984, New Brunswick Department of Natural Resources, Mineral Resources Division.

GRANULAR AGGREGATE RESOURCES IN NEW BRUNSWICK

A.A. Seaman and J.J. Thibault

Under an accelerated granular aggregate inventory program, reconnaissance mapping of the Northwest Panhandle, the Acadian Peninsula and Southeastern New Brunswick was carried out by A.A. Seaman and J.J. Thibault, with the assistance of two summer students. An area of approximately 8,500 km^2, comprising all, or parts of, sixteen 1:50,000 scale NTS map sheets, was covered (Figure 14). In addition, two granular aggregate resources mapping contracts, in Central and in Northwestern New Brunswick, were awarded under the Canada-New Brunswick Mineral Development Agreement.

Final reports for these projects will present a review of the Quaternary geology of the area covered and an assessment of the granular aggregate resource potential. Maps outlining the surficial distribution of the aggregate deposits will accompany the reports.

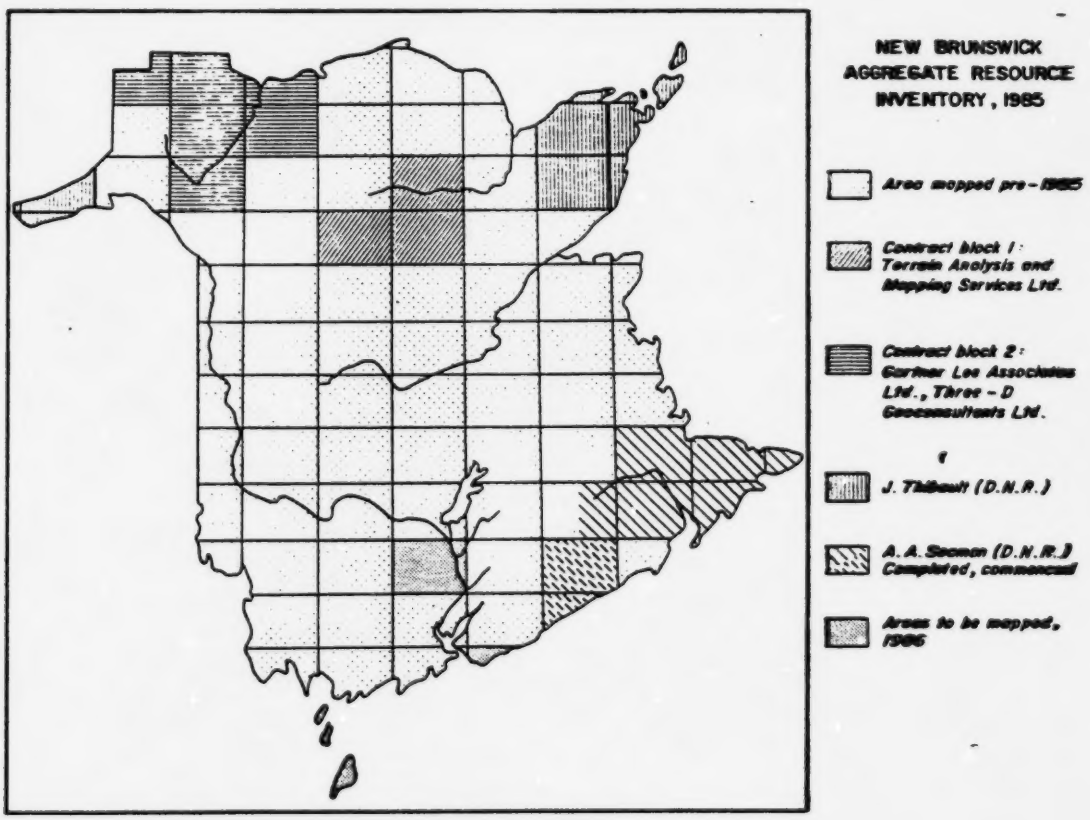

Figure 14. New Brunswick Aggregate Resource Inventory Program, 1985

SOUTHEASTERN NEW BRUNSWICK (A.A. Seaman)

The southeastern New Brunswick study area comprises all, or parts of, six 1:50,000 scale NTS map areas: Cape Tormentine (11 L/4), Port Elgin (21 I/1), Moncton (21 I/2), Petitcodiac East (21 H/14E), Hillsborough (21 H/15), and Amherst (21 H/16) (See Figure 15).

This area lies within two major physiographic regions: the New Brunswick Lowlands (to the east), a region of generally low relief; and the Caledonian Highlands (to the west), a region characterized by ridge and valley topography. The bedrock underlying the southeastern corner of the Petitcodiac East area and the southwestern portion of the Hillsborough area consists of Precambrian igneous, sedimentary and metasedimentary rocks. The remainder of the area is underlain primarily by Carboniferous sedimentary rocks, predominantly clastics. A weathered regolith commonly comprises the upper few metres of rock.

As can be seen in Figure 15, the area is largely deficient in surficial granular aggregate materials. In addition, most of the deposits are quite small, and material quality is commonly only poor to fair. The better quality deposits are restricted to portions of the Petitcodiac East and Hillsborough areas. As a consequence, extensive use has been made of bedrock as a source of aggregate. The weathered regolith serves as an abundant source of fill, while crushed rock is utilized for higher specification usage. Major quarrying and crushing operations have been developed in small areas of granitic rock to the north of Moncton and north of Memramcook.

In addition to the above area, work was commenced on the Waterford (21 H/11) and Salmon River (21 H/6) map areas lying to the southwest (see Figure 14). Investigations to date suggest that there is an abundance of good quality coarse aggregate in these areas.

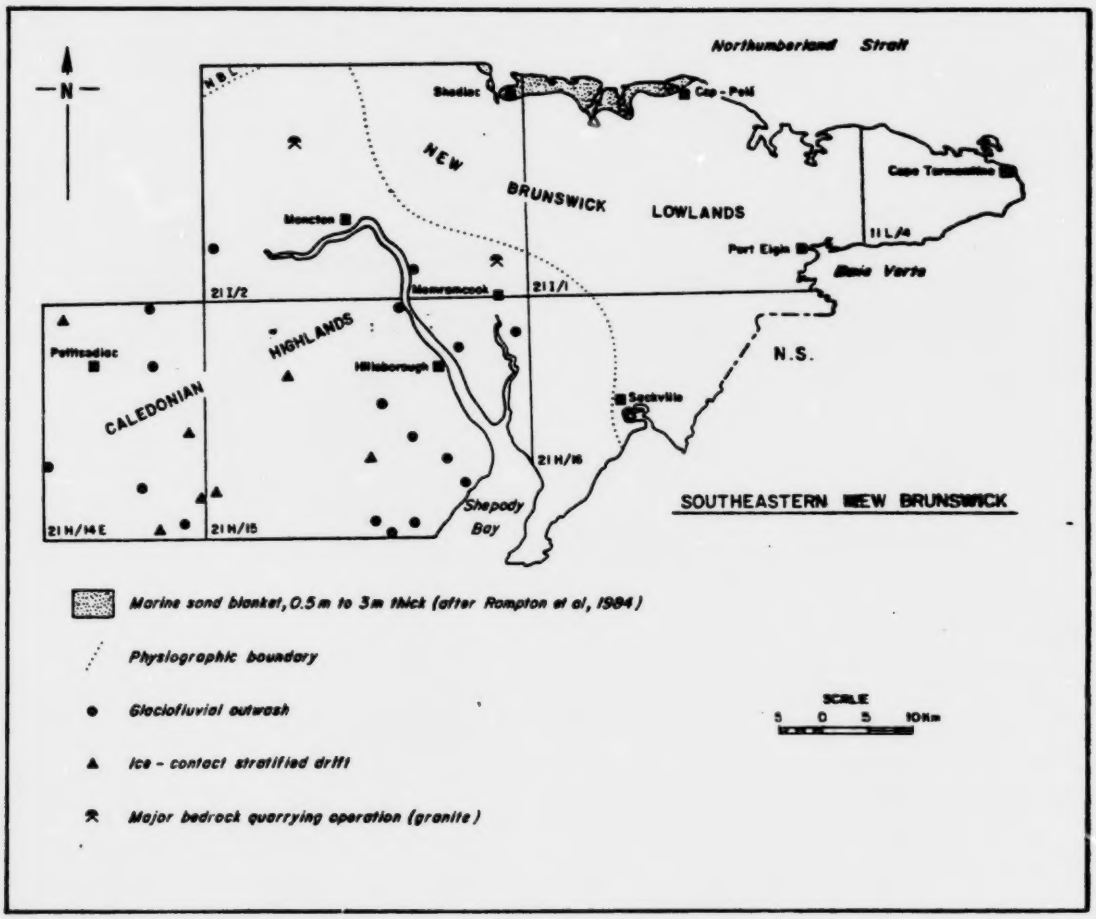

Figure 15. Granular aggregate resources of southeastern New Brunswick

THE ACADIAN PENINSULA (J.J. Thibault)

The project area (Figure 16) consisted of the following NTS map sheets: Grand-Anse (21 P/14), Caraquet (21 P/15), Burnsville (21 P/11), Tracadie (21 P/10), Tabusintac River (21 P/6), and Wishart Point (21 P/7).

The area is one of generally low relief, underlain principally by flat-lying, poorly indurated sandstones and siltstones. The upper few metres of bedrock is commonly weathered and is used extensively as a source of fill. A diabase intrusion, the Caraquet Dyke, holds some promise as a source of hard quarriable material.

The majority of the pits have been developed in material that was deposited in shallow marine waters which submerged coastal areas during and following the Late Wisconsinian deglaciation. Although the local sandstone is a poor source of hard lithologies, much of the gravel found in the area contains a relatively high percentage of hard, well-indurated lithologies. These quality gravels originated west of the Nepisiguit River and were transported east by glaciofluvial systems during deglaciation. Marine reworking of glaciofluvial deposits has also increased the relative proportion of quality lithologies in some deposits.

Outside the area that was submerged, the only major granular aggregate deposits are located within the Paquetville ice-contact system. There again, relatively high proportions of hard lithologies characterize the material. Broader textural variations are encountered and silt is commonly present in undesirable proportions.

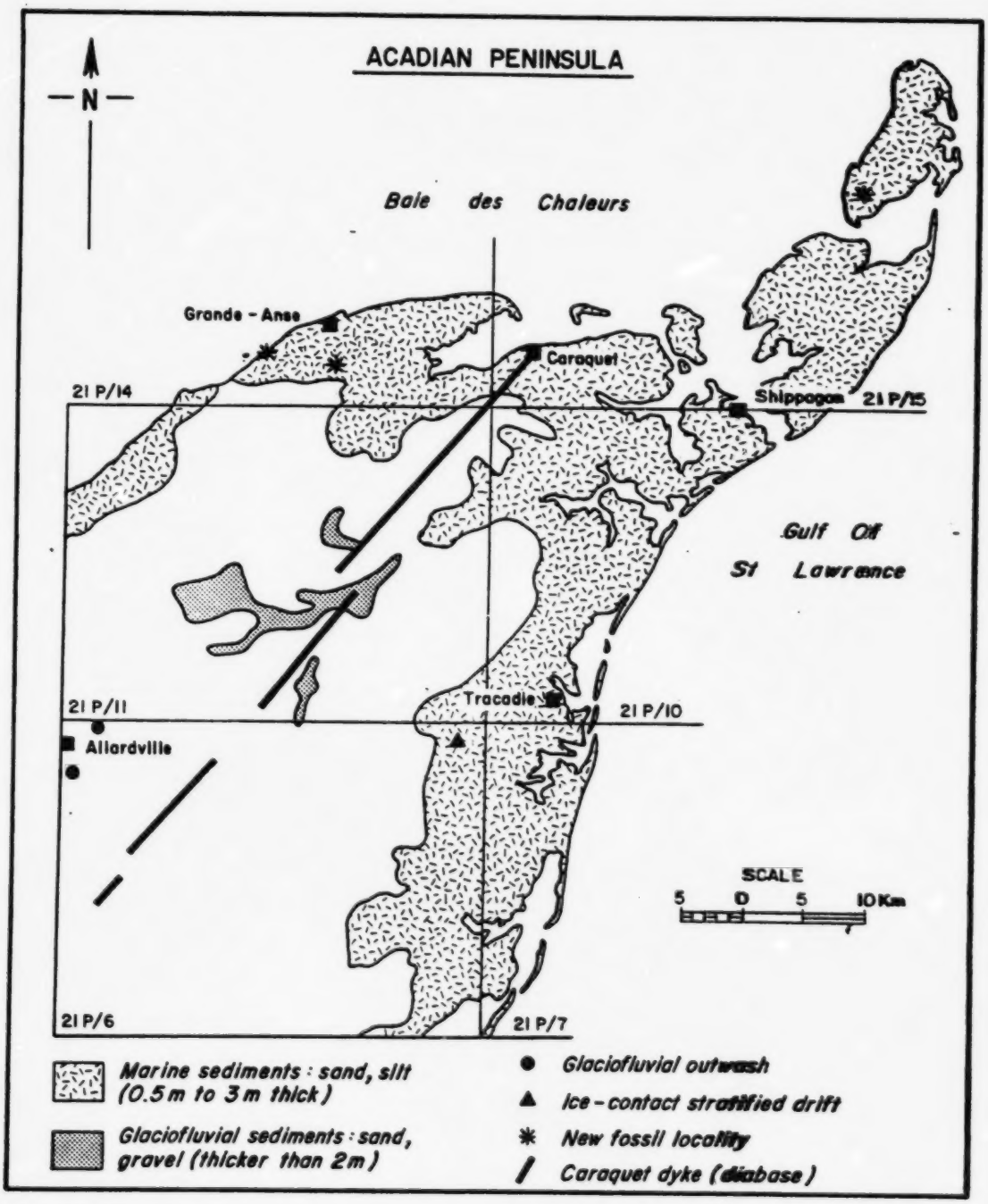

Figure 16. Granular aggregate resources of the Acadian Peninsula; significant deposits (geological boundaries after Rampton et al, 1984).

THE NORTHWEST PANHANDLE (J.J. Thibault)

The project area (Figure 17) consisted of the following NTS map sheets: Estcourt (21 N/6), Lac-Baker (21 N/7), Little Black River (21 N/3), and Connors (21 N/2).

The area is characterized by hilly rugged terrain consisting of ridges and valleys, many with a northwest-southeast orientation. The bedrock consists of grey micaceous slate and greywacke with a strongly developed slaty cleavage.

Because of the inherent fissility of the bedrock, the quality of the granular aggregate is generally poor. Major accumulations of alluvial and glaciofluvial sediments are found in the Saint John River valley near St-François-de-Madawaska. Minor ice-contact systems commonly occupy the main valleys and provide material for local usage.

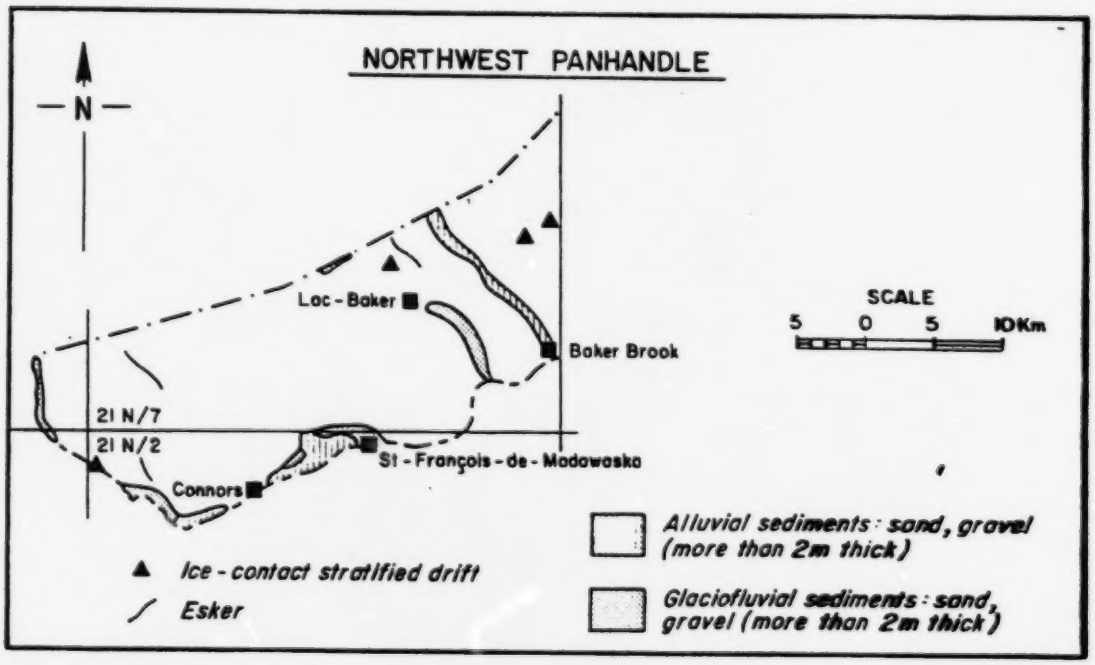

Figure 17. Granular aggregate resources of the Northwest Panhandle; significant deposits (geological boundaries after Rampton et al, 1984)

CONTRACT WORK (J.J. Thibault, Supervisor)

Two contracts were awarded under the Canada-New Brunswick Mineral Development Agreement to assist in the completion of the field mapping phase of the province-wide inventory of granular aggregate resources.

The first contract area, located in north-central New Brunswick (Figure 14), consists of the following NTS map sheets: Big Bald Mountain (21 O/1), Serpentine Lake (21 O/2) and California Lake (21 O/8). Terrain Analysis and Mapping Services Limited has been selected to undertake the study.

The second contract area, located in northwestern New Brunswick (Figure 14), consists of the following NTS map sheets: Grand River (21 O/5), Kedgwick (21 O/11), Gounamitz River (21 O/12), States Brook (21 O/13), Menneval (21 O/14), and Wild Goose Lake (21 N/16). Gartner Lee Associates Limited in conjunction with Three-D Geoconsultants Limited have been selected to undertake the study.

METALLURGICAL PROCESSING STUDIES

Dean Thibault, Process Engineer

Our primary goal is to provide technical assistance on improving extraction performance and the application of processing methods to undeveloped ores. In addition we would like to enhance the contribution of minerals to our economy by providing supportive extraction research and development. To achieve our goals we have undertaken the following projects.

A REVIEW OF PROVINCIAL METALLURGICAL PROCESSING DEVELOPMENT
PREPARED FOR: MANAGEMENT OF MINERAL RESOURCES DIVISION

The recession has impacted the natural resource companies where proper positioning involves becoming a low cost producer. In the mineral industry the technical literature has been preoccupied with ways and means of reducing extraction costs and preserving capital. The companies having research and development efforts to support further technological progress in mining and metal extraction are believed to be the survivors. There is also the hope that the demand of metals will increase and new projects will be in preparation to take advantage of new technologies and operating practices. The objective of this review is to establish a means by which the Mineral Resources Division of the Department of Forests, Mines and Energy can strengthen and diversify mineral process technology on a provincial scale. This review addresses some positive methods to meet DNR objectives in promoting secondary processing, development of ore reserves, and also to provide technical assistance to provincial processors, prospectors and other interested groups.

EVALUATION OF MAGNETIC SEPARATORS CAPACITY FOR TUNGSTEN BENEFICIATION
PREPARED FOR: MOUNT PLEASANT TUNGSTEN MINE (CONFIDENTIAL REPORT)

A high gradient magnetic separator (Sala's model 120-10) is used at Mount Pleasant Tungsten Mine to upgrade tungsten flotation concentrate. Problems with the magnetic separator have been associated with the rejection of arsenic and the recovery of wolframite less than 20 microns. The separator operation has been optimized to maximize the recovery of wolframite hence limiting the dry solid throughput capacity. A computer model has been developed to review the magnetic separator capacity as a function of wolframite recovery and arsenic rejection, and to provide a means for operators to select operating conditions.

A CASE STUDY OF DURHAM GRINDING OPERATING PARAMETERS
PREPARED FOR: DURHAM RESOURCES INC. (CONFIDENTIAL REPORT)

A study has been carried out at Durham Resources antimony mine to review the operating conditions of the grinding circuit. Samples of ore were collected and grindability test work was done to determine the mill power requirements and solid throughput restrictions. The efficiency of classification and a mass balance of the circuit were determined. The data has been collected as ground work to discuss methods of optimizing the mill performance in terms of recovery and throughput.

THE REJECTION OF ARSENOPYRITE AND LOELLINGITE USING HIGH GRADIENT MAGNETIC SEPARATION ON TUNGSTEN FLOAT CONCENTRATES
PREPARED FOR: MOUNT PLEASANT TUNGSTEN MINE (CONFIDENTIAL REPORT)

A mineralogical study of arsenic in concentrate and tails of a single pass through the magnetic separator at MPT was carried out to determine if physical entrapment of arsenic is the cause of significant amounts of arsenic in concentrate. Composite samples of feed, concentrate, and tails were collected and separated into size fractions where tungsten and arsenic were assayed in each fraction. The size fractions of feed and concentrate were run on the Frantz Isodynamic separator where operating conditions on the Frantz were selected to maintain optimum recovery of wolframite in magnetic fractions. The mineralogy of arsenic was determined in all non-magnetic and magnetic fractions. The test procedure was successful in determining the controlling factors of arsenic rejection, using high gradient magnetic separation.

STARTUP GUIDELINES FOR JOHN ZINK DeNOX FURNACE
PREPARED FOR: MOUNT PLEASANT TUNGSTEN MINE (CONFIDENTIAL FIELD STUDY)

Cold start up and commissioning briefs were discussed for the operation of a John Zink Nox abatement oxidation-reduction furnace. The deNox unit makes use of flue gas recirculation and staged combustion in order to achieve Nox abatement. This technology has been proven by John Zink on constant flows of Nox waste gas streams however the MPT application is more complex because of the variability of Nox levels in off gas from the aqua-regia leach reactors. Discussion is based on how the unit must be capable of detecting changes in Nox levels and adjusting operating conditions to achieve efficient Nox abatement.

PRECOMMISSIONING CHECK OF VACUUM FILTER INSTALLATION AT ERS-PILOT PLANT
PREPARED FOR: ENHANCED RECOVERY SYSTEMS (ERS) (CONFIDENTIAL FIELD STUDY)

The vacuum filter installations at the ERS-sulfation roast plant were reviewed to identify possible operating bottlenecks. Slurry feed systems were checked in view of optimizing filter performance. Design operating temperatures and pump capacities/ heads were checked. Recommendations were made in view of commissioning.

MODIFICATION TO UNDERFLOW SYSTEM ON MAGNETIC SEPARATOR AT MPT
PREPARED FOR: MOUNT PLEASANT TUNGSTEN MINE (CONFIDENTIAL FIELD STUDY)

A modification was designed and implemented on the slurry underflow system of the magnetic separator to improve on operator's control of solid velocity through the matrix. Samples from each slot were collected for tungsten, silica and arsenic assays and for size analysis. The derivation of solid breakthrough curves was compared to actual plant operating data. The modification was successful in establishing a known slurry velocity through each slot. Recommendations were made for further testing to establish particle size-breakthrough relationships.

REPORT OF ACTIVITY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF NEW BRUNSWICK

P.F. Williams and W.E. Hale

The school year 1984-85 has been a successful one and a bumper year for graduates; 19 students graduated with a BSc, one of them with honours; eight graduated with an MSc and four with a PhD. Once again we succeeded in publishing between 40 and 50 articles and abstracts and were successful in obtaining support from NSERC ($268,832.00) and other sources. We received a total of $52,963.00 in equipment grants from MPHEC. Additional support was received from UNB Research Fund ($5,300.00), EMR ($9,902.00), Brunswick Mining & Smelting, Heath Steele Mines Ltd. ($10,000.00), Seabright Resources Inc., DNR, CIMM, GSC, Chevron, Riocanex and others.

Undergraduate student enrolment is 99 (44 geology majors and 55 geological engineers). The number of resident graduate students increased from 22 to 26 with 16 MSc and 10 PhD students. The number of non-resident students remained at six; giving a total graduate student enrolment of 32. Of the present graduate students, eight are working on projects in New Brunswick and four are working on economic geology projects.

Geological Engineering continued to be popular with a total enrolment of 55, spread over all years. The program is being reviewed by the Canadian Accreditation Board again this year.

Dr. P.F. Williams' appointment as Chairman was extended to the end of June, 1986. Dr. Gordon Watson left the faculty this spring to join the Geological Survey of Canada. While here, Dr. Watson ordered and installed fluid inclusion equipment and began some research in the field. M. Chrzanowski will continue this work at the Department. We have had one postdoctoral fellow this year, Dr. C.K. Mawer, who continues to work on rock deformation problems. Dr. J.G. Spray of Cambridge University, England, has joined the Department as metamorphic petrologist and will take up regular duties in January, 1986.

The Geological Community of the Fredericton area hosted, at the University of New Brunswick, the very successful GAC/MAC Annual Meeting "Fredericton '85" on May 15-17, 1985. In excess of 800 delegates from 24 countries attended the three-day conference.

Approximately 400 papers covering a wide range of topics were presented during the technical sessions. Topics of considerable interest included: Turbidite-hosted gold deposits; Brines and gases in crystalline rocks; Diagenetic evolution of sedimentary basins; Rocks, minerals and materials science; Basin analysis of the Canadian Arctic Islands; Use of image analysis in geological

problem solving; Lamprophyres and lamproites; Applied mineralogy in agriculture, archaeology, forensic investigations, human health, fuel science, etc.; Crystal chemistry, Sea level changes; Ocean drilling results and New Brunswick mineral deposits.

A two-day short course on the application of electron microscopy in the earth sciences, sponsored by the Mineralogical Association of Canada, attracted much attention and was very well received by the delegates.

Eleven pre- and post-conference field excursions to areas of geological significance, emphasizing recent advances in many aspects of the geology of the Maritime region, were held in conjunction with the meeting.

A broad range of social functions including an opening reception, co-hosted by the New Brunswick Department of Natural Resources and the University of New Brunswick, formal GAC, MAC and MDD luncheons, an informal lobster 'do,' a gala banquet, and a luncheon and dinner tours to the historical village of Kings Landing, rounded out the range of activities.

REGIONAL MAPPING PROJECTS

Several members of the Department continue to be active in regional studies. R.H. Grant is continuing with his studies of Variscan tectonics west of Saint John and hopes to publish his map next year. Dr. R.K. Pickerill, in collaboration with Dr. K.L. Currie of GSC, Dr. D. Nance of the University of Ohio and a graduate student, is involved in regional mapping in the Saint John area (N.B.). I. Patel is working on the Precambrian-Cambrian boundary in New Brunswick. Dr. J.P.A. Noble is continuing his regional stratigraphic studies of the Silurian-Devonian of northern New Brunswick.

Drs. P. Stringer and K.B.S. Burke have been mapping the Early Jurassic Minister Island diabase dyke (K-Ar date 198$9 \pm$ 8 m.y.), which intrudes the Upper Devonian Perry Formation near St. Andrews. It has been traced by outcrop and local magnetic anomaly, southwest across the Oak Bay Fault into Maine where it intrudes Middle Devonian granite, and northeast through Lower Devonian volcanics towards St. George (Stringer and Burke 1985, GAC/MAC Field Excursion Guidebook No. 9). The dyke is approximately on trend with similar diabase intrusions farther east in southern New Brunswick at Seven Mile Lake, and on Prince Edward Island, but the latter are older (206 m.y., 210 m.y.). The Minister Island Dyke is similar in age to the Caraquet Dyke system of central New Brunswick, and shows similar left-lateral offset interpreted as displacement along post-Early Jurassic NW-trending strike-slip faults. The dyke does not produce a regional aeromagnetic lineament. Further

mapping and local magnetic survey work may determine if the dyke penetrates the St. George granite.

Dr. H.W. van de Poll and graduate students are continuing mapping and basin analysis of Carboniferous and Lower Permian Strata in eastern Canada and have specific project areas at present, around Tatamagouche (N.S.), Parrsboro (N.S.), the Sydney Basin (N.S.) and on Prince Edward Island. In addition, Dr. van de Poll has begun a study of sedimentary structures in the Kingsclear Group exposed along the TCH, west of Fredericton.

Dr. P.F. Williams, together with postgraduate students, continues mapping in the Dunnage Zone around eastern Notre Dame Bay (Nfld). Mapping is being carried out at various scales from 1:12,500 to 1:100 and results are being compiled for the area of the Twillingate 1:50,000 sheet at 1:25,000.

ECONOMIC DEPOSITS AND MINERALIZATION

The Department continues to be active in the economic geology field. Dr. A.L. McAllister has several projects in progress. His research continues to emphasize the general characteristics of mineral deposits and their environment. Current projects within the Atlantic Provinces are mainly centred upon Rambler, Key Anacon, Heath Steele and Brunswick No. 12, all massive volcanogenic deposits. One project is oriented toward the geochemical detection of weather-resistant mineralization. Projects being carried on by students outside the Atlantic Provinces include one on mineralization in the Adirondacks. Dr. D.J. Bachinski and his graduate students continue work on massive sulphide occurrences in the Canadian Appalachians with detailed studies on Fe-Cu-Zn deposits in the Fournier Group and in Newfoundland. Dr. Bachinski and Dr. McAllister are supervising a Bathurst Mining and Smelting-supported study on gold in the Bathurst-type deposits.

Drs. McAllister and Williams are supervising a new project at the Heath Steele Mine. This study is aimed at clarifying the structure and the relationship of the various ore bodies.

Dr. W.E. Hale, with H. Hassan and M. Chrzanowski, is undertaking a GSC-supported (MDA) metallogenic study of uranium in New Brunswick. An MSc study of sedimentological and mineralogical characteristics of off-shore Nova Scotia gold occurrences was completed in September. A study of placer occurrence potential in New Brunswick is being carried out with DFME support under the MDA.

Dr. P.F. Williams and Dr. D.J. Bachinski completed supervision of Cees van Staal's project in the area of Brunswick #6 and #12 Mines and Austin Brook.

Dr. H.W. van de Poll continues his interest in the economic geology of the Permo-Carboniferous of N.B., N.S. and P.E.I. with emphasis on the lithostratigraphy, sedimentology and paleoclimatic evolution of coal basins and the Prince Edward Island redbeds for an overall evaluation of their economic potential with respect to coal, gravel, copper, uranium and natural gas.

Dr. R.K. Pickerill is continuing supervision of an MDA-sponsored graduate project on the Albert Formation. The project involves detailed sedimentology and diagenetic studies of the formation. One of his graduate students, D. Carter, has just completed his MSc thesis on the stratigraphy, sedimentology and regional facies analysis of the Moncton Sub-basin.

Dr. C.K. Mawer and Dr. P.F. Williams are involved in a detailed structural and metamorphic study of quartz vein genesis in the Cambro-Ordovician Meguma Terrane of Nova Scotia. These quartz veins were the source of considerable quantities of gold.

GEOCHEMISTRY

Dr. N.J. Susak is continuing studies of metal solvation and transport mechanisms. Spectrophotometric studies on cobalt-chloride complexes are complete to 90°C. Construction of high temperature cells, to extend these studies to 300°C, is nearly complete. He has also initiated a hydrothermal solubility study of cobalt and nickel oxides.

GEOPHYSICS

K. Burke, together with three students from the Geology-Physics program, J. Carr, D. Richard and A. Vickers, investigated the microseismic activity in the epicentral region of the 1982 Miramichi earthquakes under a contract with the Earth Physics Branch of EMR. Over 300 microearthquakes were recorded during a seven week period in July and August, with magnitudes ranging up to m_N = 2.8. Most of the activity was in the northeast quadrant of the original 6 x 6 km epicentral area of the 1982 aftershock activity.

K. Burke and G. Leblanc of Weston Geophysical Corp. have completed their reevaluation of 1817, 1855, 1869 and 1904 earthquakes of the New Brunswick-Maine region. A study contracted by EMR on the historical seismicity of the northern part of New Brunswick has also been completed. A study has commenced of the historical seismicity of the southern part of the province. The studies completed so far confirm that the Central Highlands, Passamoquoddy Bay and the Moncton Dorchester regions have been

places of continuing earthquake activity, and all reported earthquakes of magnitude greater than 4.5 with epicentres in New Brunswick, have been in these regions.

G. Allcott has started an MSc project designed to evaluate the use of geophysical methods at Heath Steele Mine, with partial support from DNR. So far, electrical conductivity and magnetic susceptibility measurements of core samples have been made and detailed ground magnetic surveys are in progress.

PALAEONTOLOGY

Dr. A. Logan is continuing actuopalaeontological studies of modern hard substrate communities in the Bay of Fundy with a view to ascertaining their value for palaeoecological reconstruction in the Mesozoic. He is also working on competitive interactions of hermatypic corals in Bermuda and their significance in terms of distribution and succession of similar species in Tertiary and Pleistocene reefs. Dr. J.P.A. Noble together with graduate students continues his studies of Palaeozoic fossil assemblages with emphasis on Silurian corals and stromatoporoids and the relation of the New Brunswick and Gaspé faunas to those of other circum-Atlantic areas as a 'tool' in reconstructing plate movements.

Dr. R.K. Pickerill, who this year was elected Chairman of the Trace Fossil Research Group of the Society of Economic Palaeontologists and Mineralogists, is continuing work on the structure, composition, ecology and evolution of Silurian (Llandovery) brachiopod-dominated communities of Arisaig (N.S.) with Dr. J.M. Hurst. Additionally, he is making a study of the structure, composition and evolution of Ordovician marine benthic communities in Quebec with Dr. T.L. Harland and in Wales with Dr. P.J. Brenchley. He is also collaborating with Dr. M. Wade of the Queensland Museum, Australia, in a study of Cambrian jellyfish from the Saint John area. He continues his extensive trace fossil research in Spain, Portugal, Quebec, Newfoundland, New Brunswick, Alaska, Oregon and southern California.

PETROLOGY

Dr. S.W. Bachinski is continuing her work on the geochemistry, mineralogy and petrology of lamprophyres from New Brunswick and elsewhere and Dr. L.T. Trembath is studying crystallization of feldspar in synthetic and natural systems. This latter project is concerned with a comparison of microstructure in natural and experimentally produced, compositionally equivalent crystalline material and is aimed at developing a better understanding of the crystallization and emplacement of granitoids.

SEDIMENTOLOGY

Dr. J.P.A. Noble is continuing with stratigraphic and sedimentary studies, including a study of diagenesis, in northern New Brunswick and Gaspé as part of a Silurian-Devonian Appalachian basin project.

I. Patel is continuing a study of the sedimentology of the early Lower Cambrian, Ratcliffe Brook Formation in southeastern New Brunswick and is attempting correlation with similar sequences in parts of the northern Appalachians and Europe.

Dr. R.K. Pickerill is contributing sedimentological work to a regional study of the Saint John Group, as mentioned above, and a PhD student is currently writing his thesis.

In addition to the obvious sedimentological bias of their regional project mentioned above, Dr. H. W. van de Poll and I. Patel are continuing work on physical diagenesis. They are augmenting this study with laboratory tank experiments, by means of which they are replicating many of the structures observed in the field. This work has implications for petroleum reservoir studies, facies analysis and paleoseismic interpretations.

STRUCTURAL GEOLOGY

Dr. P. Stringer is continuing structural mapping in southern New Brunswick on the supposed Triassic Lepreau Formation. His work there indicates intense deformation correlative with the Hercynian (Carboniferous) Orogeny on the Lepreau peninsula.

Dr. J.C. White is involved with a program initiated by the Geological Survey of Canada to study faulting in the Stellarton coal basin, Nova Scotia. In addition, he is working jointly on an examination of the feldspar-rich horizons bounding the Hemlo gold deposit and continuing research on deep crustal shear zones in Ontario.

Dr. Williams and students are working on major faults in Atlantic Canada including the Dover Fault (with Caron), faults in southern New Brunswick (with Leger), the Cobequid-Chedabucto Fault (with Mawer) and on the Indian Islands Fault (Nfld). The objective of these studies is to synthesize Acadian ductile and brittle faulting history as a basis of understanding its influence on Carboniferous sedimentation and emplacement of quartz and calcite veins, many of which are related to the faults.

FIELD RELATIONS, PETROGENESIS, AGE, AND ECONOMIC POTENTIAL OF PLUTONIC AND ASSOCIATED METAVOLCANIC ROCKS EASTERN CALEDONIA HIGHLANDS, NEW BRUNSWICK

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Geological mapping in the eastern Caledonia Highlands of southern New Brunswick during the summer of 1985 covered an area of approximately 160 km^2 centred on the Forty-Five River pluton north of Alma. A 1:20,000 scale map is being compiled for this area. Approximately 320 samples collected for petrographic studies from plutonic rocks and their host metavolcanic and metasedimentary rocks, and 30 representative samples, are being analyzed for major and trace elements. An additional 30 samples were collected on a reconnaissance basis from plutonic units throughout the Caledonian Highlands east of Highway 114 for comparison with those in the map area and as a pilot study for future work in the area. Selected samples will be used for Rb-Sr age dating.

The purpose of this study is to examine in detail the distribution, field relations, lithology and chemical composition of the plutonic rocks in the area, as well as their host metavolcanic rocks, in order to interpret their petrogenesis and tectonic setting, assess their economic potential and compare them to units inferred to be of similar age elsewhere in the region, especially southeastern Cape Breton Island.

Preliminary results indicate that the plutonic rocks are mainly hornblende-bearing diorite, quartz diorite and granodiorite. There is no evidence for more than one age of plutonism, and the intrusions are inferred to be comagmatic. Host metavolcanic rocks are mainly medium- to fine-grained intermediate to felsic crystal tuffs now metamorphosed to slate and phyllite. Local occurrences of ignimbrite and lack of evidence for submarine origin suggests that the volcanic rocks are subaerial. However, primary textures are largely destroyed by development of metamorphic foliation and widespread pervasive cataclastic deformation which also affected the plutonic rocks. The Teahan Zn-Cu-Pb-Ag-Au prospect appears to be hosted by a felsic phyllitic unit. Similar units occur elsewhere in the map area and typically contain abundant pyrite. Pyritic quartz veins are also widespread. Meta-arkose and metaconglomerate units post-date both the volcanic and the plutonic rocks, but generally have been deformed, and possibly metamorphosed, with the older rocks.

STUDY OF GRANITOID ROCKS IN NEW BRUNSWICK

J. B. Whalen
Geological Survey of Canada
Ottawa

During the summer of 1985, a suite of 232 representative samples of the granitoid rocks of New Brunswick were collected from both undeformed and deformed intrusions.

Geochemical work on these samples will: (i) help identify the tectonic environment in which the different granites formed (eg. oceanic island-arc, continental island-arc, Andean-type margin, Himalayan-type margin or within-plate setting); this information is important for large-scale tectonic and metallogenic models of the New Brunswick Appalachians. (ii) indicate the economic potential of the various intrusions by correctly classifying the granite types (ie. I-, S-, A- or M-type (igneous, sedimentary, anorogenic or mantle type)) and by analyzing for elements of economic importance in granites (Sn, W, Mo, Ta, Cu and rare earth elements). (iii) in conjunction with isotopic work, resolve the different ages of intrusive rocks present in the province. Particular ages of intrusion (eg. Carboniferous) may be more favourable for granite-related mineralization.

During the past field season a number of new occurrences of anorogenic or A-type granites were identified and it is thought that much of the significant granite-related mineralization in New Brunswick (eg. Sn-W-Mo mineralization at Burnthill, Mt. Pleasant and St. George Batholith) are associated with A-type granites.

METALLOGENY OF CENTRAL AND SOUTHWEST MIRAMICHI ZONE, NEW BRUNSWICK[1]

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The study area is the belt of Cambro-Ordovician volcanic, sedimentary and metamorphic rocks, and plutonic rocks of various ages extending southwest from the Bathurst-Newcastle area to the Woodstock area. Information on metallic mineral occurrences in the belt has been compiled from assessment file reports and published regional maps. Field mapping of these occurrences and surrounding host rocks is underway. The determination of processes involved in the concentration of metals will be studied by examining outcrops in detail while considering the various tectonic settings.

Basic descriptions are being written because many of the minor showings are poorly described in existing data files. For most sites, maps or sketches are being prepared (scales varying from 1:100 to 1:5000). Much attention is being given to structures at the showings and in the surrounding areas. Specimens are being collected for megascopic comparisoms and minor microscopic studies. Where there is a lack of data on trace and precious elements, samples are being collected for analyses. Some wall rocks are being sampled to document chemical changes. Where there has been a lack of geophysical work, and where electrical and magnetic information would help to interpret fracturing and alteration, single VLF-EM and magnetic profiles are being read.

This project involves liaison with Cees van Staal on Bathurst area structures, J. Whalen on the plutonic rocks, H.E. MacLellan and R. Taylor on the Burnthill-Dungarvon Sn-W district and Gordon Watson on the metallogeny of the adjacent Silurian-Devonian belts. Certain showings in the latter two project areas are being visited by us for purposes of drawing comparisons.

1 Contribution to the Canada-New Brunswick Mineral Development Agreement. Project carried by Geological Survey of Canada.

GEOLOGY OF THE NICKEL-COPPER DEPOSITS OF THE ST. STEPHEN COMPLEX, NEW BRUNSWICK[1]

A. Dogan Paktunc

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Geological mapping of the St. Stephen mafic-ultramafic complex (Dunham, 1950) and logging of the available diamond drill core were carried out during the summer of 1985. Many features of the intrusion are comparable to those of the mafic-ultramafic intrusions of the Maine Appalachians. The complex appears to have been synorogenically emplaced into Lower Ordovician Charlotte Group sedimentary rocks during the Acadian Orogeny. Two K-Ar age determinations on hornblendes (Wanless et al., 1973) imdicate an Early Devonian age for the complex. Medium-grade pelitic hornfels was developed in host rocks surrounding the complex amd in host rock inclusions within the complex. The following lithologic units, listed in order of decreasing abundance, make up the complex; troctolite, gabbro, peridotite, norite and anorthosite (Figure 18). The contacts between these units appear to be gradational. Layering is not observed whereas cumulus textures and igneous lamination defined by plagioclase and olivine lineations are well developed.

Most of the known mineralized zones occur in the northern half of the intrusion in association with ultramafic rocks and strongly altered "mafic" rocks. These ore zones, which seem to be aligned along a north-northeasterly direction, consist of massive, semi-massive and disseminated sulfides. Matrix sulfides, occupying the interstices between cumulus olivine grains in peridotite, and immiscible sulfide droplets in various other rock types indicate the presence of magmatic sulfides during the crystallization of basaltic magma. For these reasons the deposits are considered to be magmatic. Presence of abundant sulfide-rich country rock fragments within the intrusion suggests that assimilation of crustal rocks played an important role in the formation of immiscible sulfides.

1 Contribution to Canada-New Brunswick Mineral Development Agreement. Project carried by Geological Survey of Canada, Economic Geology and Mineralogy Division.

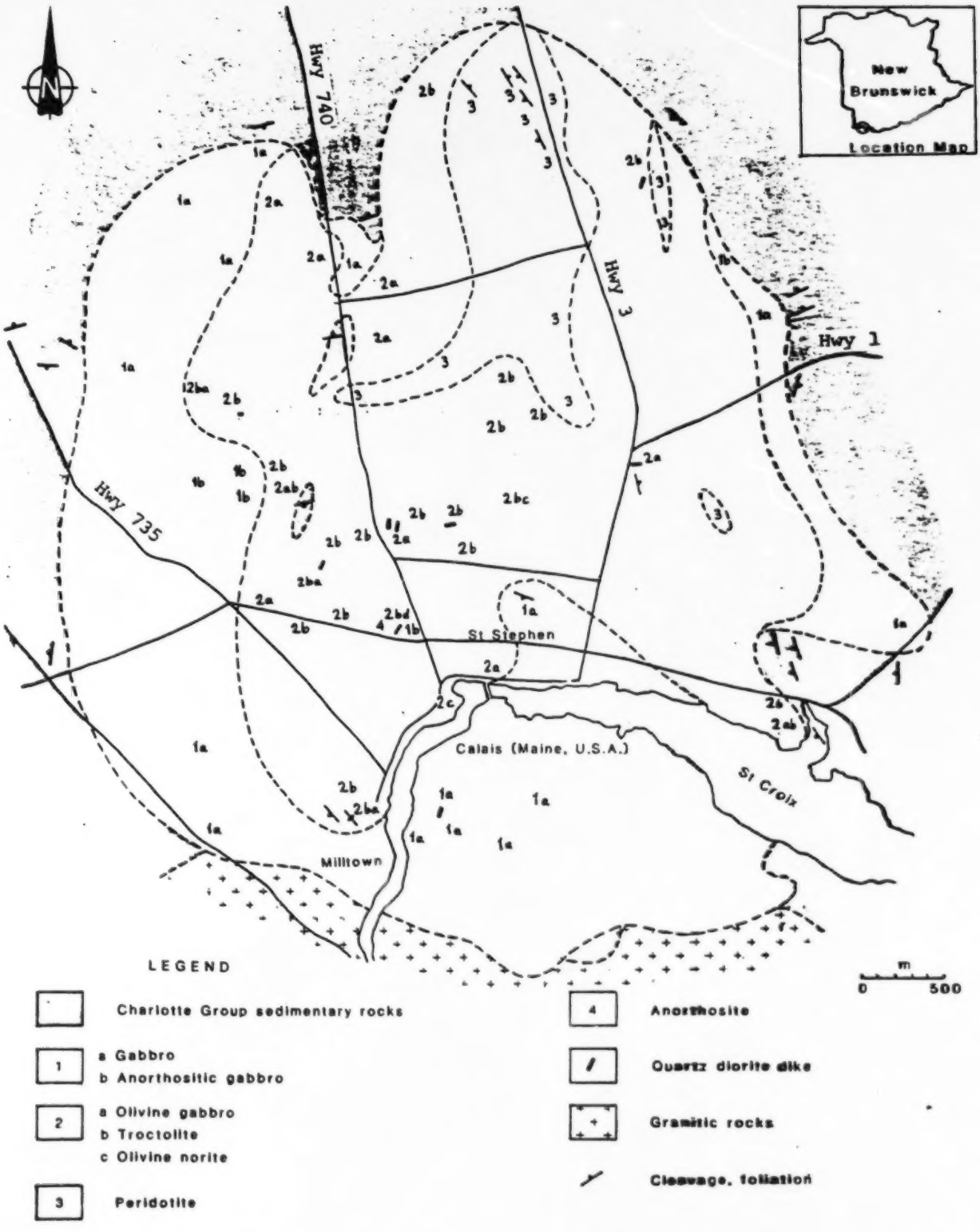

Figure 18. Geology of the St. Stephen Complex. Geological boundaries in the U.S.A. portion of the complex after Ludman (1985).

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METALLOGENY OF THE CHALEUR BAY BELT[1]

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The Chaleur Bay Belt is a belt of Silurian and Devonian volcanic and sedimentary rocks which trend northeast along the west margin of the Miramichi Zone (Fig.19). The area has been previously referred to as the Chaleur Bay Synclinorium (Rogers, 1970), the Tobique Zone (Potter et al., 1969), the Tobique-Chaleur Zone by New Brunswick provincial geologists and is the northern portion of the Piscataquis Volcanic Arc (Bradley, 1983).

During July, 1985 a regional metallogenic study of the Silurian-Devonian rocks and associated intrusions in the Chaleur Bay Belt was initiated. The project involves documentation of base and precious metal occurrences in the belt and will include geochronology, alteration studies and lithogeochemical studies. Emphasis will be on the location of these occurrences within the regional stratigraphic setting and their relationship to particular time intervals, rock units or specific episodes of volcanic and intrusive activity. Improved documentation and genetic interpretation of base and precious metal occurrences in the Chaleur Bay Belt will aid mineral exploration and serve to outline new areas of potential exploration interest.

Field work this year involved regional reconnaissance of the Chaleur Bay Belt and initiation of detailed studies of three deposits within the belt: Nash Creek, Mount Costigan and Gravel Hill. The following brief descriptions of these deposits are based on previous work by company and provincial geologists and preliminary results of this study.

NASH CREEK

The Nash Creek deposit is approximately 6.5 km southwest of Jacquet River (Fig.19). Mineral occurrences in the area were first discovered by Hawkes, Riddell and Bloom in 1953 during an experimental stream sediment survey (Hawks, 1976). Previous exploration work was performed by American Metals and Malarctic Gold Fields, Dome Exploration, Clearwater Mines, St. Lucie Exploration and C.G. Cheriton. The property is currently controlled by Kidd Creek Mines Ltd.

The area is underlain by part of the Lower Devonian Dalhousie Group which includes mafic volcanic flows and tuffs, rhyolite flows and sedimentary rocks. The principal structure of the Jacquet River area is a north-south graben zone

[1] Contribution to Canada-New Brunswick Mineral Development Agreement. Project carried by Geological Survey of Canada.

Figure 19. Location of Chaleur Bay Belt and Nash Creek, Mt. Costigan and Gravel Hill deposits.

(Pajari et al., 1977). The graben is pre-Pennsylvanian since it is overstepped by the Bonaventure Formation of Pennsylvanian age (Greiner, 1970; Davies, 1972). Folded Devonian rocks within the graben have gentle to moderate dips, an overall north-south trend and are generally uncleaved.

The Nash Creek deposit is hosted by a generally flat-lying sequence of volcanic rocks of the Dalhousie Group which have been divided into three informal units: the Lower Basalt Sequence, the Mixed Felsic Sequence and the Upper Basalt Sequence (Moore, 1978, 1981). Sphalerite, galena and pyrite with some marcasite and barite are present in several zones as semi-massive to massive sulfides at or near flow contacts or as discontinuous sulfide stringers. Typical assay values for these zones are 2% Zn, 1% Pb and 0.40 oz/ton Ag.

MOUNT COSTIGAN

The Mount Costigan deposit is approximately 26 km east of Plaster Rock (Fig.19), on the western margin of the Trousers Lake area. The area was first staked in 1954 by Selco Exploration on the basis of regional stream sediment lead-zinc anomalies. Further work was done by Mount Costigan Mines, Silican Mines, Amoco Petroleum and, most recently, Minerais Lac Ltee (Fyffe and Pronk, 1985). The property is presently controlled by Amoco Canada Petroleum Company Ltd.

The area is underlain by sedimentary and volcanic rocks of the Lower Devonian Tobique Group. The deposit, located 250 metres east of the highest point on the Costigan Mountains, occurs within felsic volcanic rocks of the Costigan Mountain Formation. Geologic mapping has shown that these volcanic rocks are overlain to the west by sedimentary rocks and diamond drilling has shown they are underlain by sedimentary rocks to the east (Crevier, 1984). The volcanic and sedimentary rocks strike north to north-west and dip to the west about 40°. Stratigraphy is normal with tops to the west.

The Costigan Mountain Formation consists of basal mafic volcanic rocks intercalated with less abundant sedimentary rocks, followed upward by flow-layered rhyolite which also contains sedimentary rock interbeds. Overlying the rhyolite is a chloritic crystal tuff which is overlain in turn by felsic lapilli tuff and massive to weakly flow-banded felsic flow rocks (Fyffe and Pronk, 1985).

The Mount Costigan deposit occurs within the chloritic crystal tuff unit. Ore minerals are concentrated in the core of an east-plunging breccia-pipe approximately 200 metres in diameter. Pyrite, sphalerite, galena and minor chalcopyrite, typically associated with fluorite, occur in stockwork veinlets and are disseminated within the silicified breccia filling of the pipe. Alteration of the country rock extends up to 200 m

from the breccia-pipe. Anomalous values of Zn, Pb, S and F occur in both silicified country rocks and breccias, although visible sulfide minerals are observed only in the latter (Crevier, 1984). The known mineralized zone contains less than 10 million tonnes of material with typical grade of 1.85% Zn, 1.4% Pb and 0.52 oz/ton Ag (Crevier, 1984).

GRAVEL HILL

The Gravel Hill deposit is approximately 3.5 km northwest of Millville (Fig.19). The property was initially discovered by R.J. Connor, a Millville prospector, who optioned it to Amax Potash Ltd. in 1978. Subsequent work was performed by the New Brunswick Department of Natural Resources and Billiton Canada Ltd. The property is currently controlled by Connor.

The Millville area is underlain by an outlier of the Lower Devonian Tobique Group, consisting mainly of felsic and intermediate to mafic volcanic rocks. These rocks trend northeast and are bounded by Ordovician rocks to the south and east and by Silurian sedimentary rocks (Smyrna Mills Formation) to the north. Locally, the mafic volcanic rocks are predominant, and are generally mafic tuffs or andesites with several, relatively thin, intercalated layers of sedimentary rock. The felsic volcanic rocks are mainly rhyolite and pyroclastic rocks (lapilli tuff, breccias). The rocks at Gravel Hill are slightly folded, vertical to steep south dipping and cut by numerous regional faults (Lutes, 1984).

At Gravel Hill, the mineral occurrences are within silicified, brecciated rhyolite, coarse lapilli tuffs and volcanic breccias immediately below a sequence of mafic volcanic rock which has intercalated shale-siltstone horizons. Three main mineralized zones occur near surface and diamond drilling indicates these may thicken and increase in metal content with depth (Lutes, 1984). Sphalerite, galena, chalcopyrite, jamesonite, with minor arsenopyrite, tetrahedrite and native silver occur with abundant pyrite as stringers and veinlets with rare massive and disseminated sections. Pyrite is also common as disseminations within footwall rocks. Typical assay values of mineralized zones at Gravel Hill are 2-5% combined Pb+Zn, 0.1% Cu, 1 to 8 oz/ton Ag, 0.02 to 0.10 oz/ton Au. Gold and silver although associated with sulfide minerals do not increase proportionally and values are very erratic.

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